

The importance that Competency-Based Training has today in Higher Education has led to the number of scholars on the subject increasing in recent years, being remarkable the number of articles on this area of knowledge found in various publications, generating the emergence of definitions and points of view that tend to create an epistemological situation that tends to create ambiguities, that in certain circumstances could create confusion in readers not familiar with the diversity of related topics. An aspect that should not be ignored by people who are interested in the study of Professional Competences, first from the conceptual and then its link with various spheres of knowledge, is the complex and polysemic character on which this context of science is developed. It is the specific purpose of this study to critically analyze this epistemological reality, around which many of the works on professional skills that deserve the attention of specialists from various branches of human knowledge. This work corresponds to the original version, in Spanish, published by Editorial EAE in 2017.



The main author of the work has been a university professor for more than 50 years, and has published more than 20 titles in Technical and Humanistic Sciences, among others, several of them translated into 6 languages.



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Professional Competencies

Epistemological, inclusive and generalizing vision



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Professional Competencies
Epistemological, inclusive and generalizing vision.

Practical case: Graphic Engineering

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INTRODUCTION

*A society is ready when all or most of its citizens are;
An individual is prepared when he can face the problems
that arise in his job and solves them (1)*

The importance that Competency-Based Training has today in Higher Education has led to the number of scholars on the subject increasing in recent years, being remarkable the number of articles on this area of knowledge found in various publications, generating the emergence of definitions and points of view that tend to create an epistemological situation that tends to create ambiguities, that in certain circumstances could create confusion in readers not familiar with the diversity of related topics.

An aspect that should not be ignored by people who are interested in the study of Professional Competences, first from the conceptual and then its link with various spheres of knowledge, is the complex and polysemic character on which this context of science is developed.

It is the specific purpose of this study to critically analyze this epistemological reality, around which many of the works on professional skills that deserve the attention of specialists from various branches of human knowledge are presented and based today, at least in two distinct directions: as a field of training of specialists depending on the complex industrial and business world; and as a field of post-training and professional materialization, when the challenge of the educated and trained man that the world needs is to become competent to perform a job.

Making a study on Professional Competences, with the aspiration that this is of interest to readers of countries where Higher Education, based on competences is common knowledge, is undoubtedly a real challenge very difficult to address, because it requires reconciling the objective of one's own work, with the approaches that are assumed in an extremely complex and diverse context, where what is likely to be common is the need to

¹Carlos M. Álvarez de Zayas (1999)

conceptualize and classify, without tacitly defining what should be conceptualized and/or classified.

The first difficulty is that it is not always clear in which the objective of the work is focused, since implicitly the expression "*professional competences*" is polysemic in nature, and it is not stated whether the content will be focused on the identification of a certain capacity to execute a task in the workplace, with the best performance, or we are simply interested in guiding the FORMATION of that capacity, which to be complete must consider its levels of training, and consider or not the period of post-graduate training, which is where increasing performance is achieved.

But the questions do not end there. If the objective is the second – training – assuming a certain model of professional competences already established, such as the European standard, then the question to be defined is: Is it competency-based training?; Are curricula based on the competency approach?; Are there educational proposals related to competences?... (Díaz Barriga, A. 2006).

At times, one might think that we are facing a veritable terminological labyrinth. However, this issue is not exclusive to this field, as will be shown in the body of the work.

This diversity contrasts, nevertheless, when publications dedicated to competency-based training exclude other training models. These models, although not explicitly aligned with competency-based training, still produce competent professionals and competent citizens...

The intention of this work is to reveal this epistemological reality surrounding the context in which many of the works on professional competences are presented and grounded today. Whether they belong to the field of Pedagogical Sciences, as a domain for competency formation, or to the complex industrial, business, and service world, professional competences as an object of study would not make sense unless they serve to identify and enable the preparation of educated and skilled individuals that the world needs to become competent and successfully address the challenges presented in their jobs (Álvarez de Zayas, C, 1999:6).

The work presented here also includes an inclusive analysis of the Cuban model of professional training. Although not explicitly based on competency-based training, it aims to produce graduates capable of solving specific problems at the Base Link level, akin to competency-based outcomes.

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Polysemic nature of the concept of professional competencies

1.1. Do you really know what is meant by professional skills?

A little over ten years ago, Acosta, F, co-author of this work, carried out a study on the problem of “terminological ambiguity in Sciences”, which was published in the OEI magazine, under the title of “ Do you really know what a paradigm is?” (Acosta, F. 2005), in which it is evident to what extent such reality affects the clear interpretation of scientific literature.

To the surprise of the author, who initially became interested in the problem out of essentially epistemological curiosity, the final result was a discovery: the topic interests many people; and the article, from then until today, has been reproduced in magazines and websites that are interested in scientific and educational content.

A similar situation occurs in the topic that concerns us now. As stated in Eneas Alvarez, M. (2003), before presenting an approach to the definition of the concept of professional competencies *"it is considered necessary to make a brief introduction about the complex, changing and polysemic nature of the term"*, also highlighting its *"relativity"* and the meaning that can be attributed to it. That is, many meanings and implications are hidden behind the concept.

For his part, in parallel, Tejada, J. (1999) had already made an interesting attempt to conceptualize these competencies, starting from the lexicological analysis of the term and the study of some of the definition proposals. Surely some of these experiences were later incorporated into the base research of the Tuning Project.

Such reality means that in certain circumstances a researcher/author feels that it is tortuous to delimit the concept of competence, since in any basic review of the specialized literature, different views on the term are evident, from the psychological, pedagogical, linguistic, among others. contexts (Correa Bautista, J, 2007), creating a crossroads, which inevitably must be resolved along the way.

Regarding their specific evolution in the academic field, the competencies have assumed different names or it may even be the case that they are not identified as such, although they are obviously declared implicitly in the assumed training model, as is the case of the Cuban model, current in Higher Education (Horruitiner, S. 2005, 2006; García, M., Ortiz, T. and González, T, 2013), which is discussed in the final chapter of this work.

In seeking to form a theoretical framework capable of supporting the existence of the wide variety of equivalent terms and concepts, the authors analyzed, identified and reconciled the possible components of an object of study that is balanced and inclusive of a concept of Professional Competencies; and that admits a generic definition, which is compatible with the object itself.

This terminological diversification, and its consequences, are presented very concisely in Díaz Barriga, A, (2006: 8), when he expresses that most of the literature dedicated to these topics has neglected or ignored the conceptual problem, of So the various applications of the competency approach *“tend to be partial, sometimes superficial, which is a consequence of the refusal, very generalized in the field of education, to address the conceptual problems that underlie the concept of competencies.”*

From this essentially epistemological analysis, it becomes evident that the tendency towards which most authors converge is to consider professional competence directly associated with the individual's ability to integrate the knowledge and skills acquired (during training and in first phase of performance), with the skills and attitudes that to some extent are encapsulated in the nature of the human BEING, together with the values that distinguish and complement it, to form part of a personality that may or may not be desirable, at the time to demonstrate the ability to KNOW HOW TO DO a task, in which you must put into practice, in accordance with the technical and social demands, your potential as a person, in relation to another, and all in turn, compared with an ideal model of an individual , which brings together the desirable characteristics for the performance of a job.

In this sense, Escobar, M. and Quindemil, E. (2015) state that the results and experiences obtained in various educational centers in the international context, competency-based training presupposes *“a set of knowledge,*

procedures and attitudes combined, coordinated and integrated for professional practice that make the individual a person capable of acting efficiently in aspects where the professional knowledge associated with the practice is required”.

As we will see, trying to approach the concept of Professional Competencies requires a basic epistemological approach, which leaves the way open to the integration of convergent trends, so that it is feasible to incorporate experiences from educational systems that, in parallel, also seek the professional excellence, without tacitly adjusting to any of the international models assumed by one university or another, rather following its own paths, which have also valid experiences.

Therefore, without it being a declared objective, this claim adjoins, has points of contact, with procedural aspects present in the holistic treatment of knowledge, which is usually present in the so-called Complex Thinking.²

In fact, to be consistent with the aforementioned purpose, which considers integrating in this study, in the broadest way possible, the opinions of as many authors as reasonably convenient, it has been necessary to handle a variety of related terms (skills, mode of action, performance, identification of the base link, etc.) without losing the essence of trying to illustrate the topic, thinking of readers who, without being unfamiliar with the subject, may be interested in understanding the basis of similar experiences carried out in training contexts. professional.

Furthermore, the aim is to leave the space open for exchange and/or controversy, in the search for a vision that is broader for everyone, if you want a greater “*harmony*”, as the parents of projects such as Tuning proposed. (González, J. &Wagenaar, R. 2003), which remains valid from its very genesis.

Accepting these premises, it is possible to link parallel objectives, which add to excellence the indispensable search for innovation, and the need for

² Philosophical conception, founded by Edgar Morin, which sees the world as an inseparable whole, where the individual (man) has ambiguous, disordered knowledge. It is then proposed that the common point between the main disciplines is the recognition that our reality is complex: it cannot be contemplated from a disjunctive, reductionist, simplifying and predominantly uncritical thinking. From a psychological perspective, this type of thinking is conceptualized as “that capable of deepening critically in the essence of the phenomena, playing with uncertainty and conceiving the organization” (Fariñas, 2006: 6).

standardization, establishing standards that force manuals such as the Oslo one to be taken into consideration.³, Bogotá⁴ and its more specific similar ones, although this is not tacitly reflected in the majority of the works consulted.

Thus, in the opinion of the authors, such aspiration cannot be achieved –with a minimum of certainty– if we do not begin by recognizing, as an indispensable premise, that any vocational training model that is assumed, that works on professional skills explicitly. or implicit, requires for its implementation an interdisciplinary conception that is not always talked about, although it must necessarily be taken into account, and that institutional and governmental will be added to that conception, as certainly happened with the Turing Project, born as result of the Bologna Declaration of 1999 (Conference, 2002), regardless of the divergent opinions that always exist when projects with a diversity of social interests are launched.

That being the case, it is worth starting from the origins...

1.2 Background. Holistic analysis of the concept of competencies

It is known that in times prior to integration into the EHEA, the study plans focused their teaching on learning the specific skills of each degree. The competencies, which today are called generic or transversal, were worked on collaterally and were not considered as evaluative aspects, especially in the study plans of technical science careers. It was not an event that occurred in isolation in Europe, but also occurred on the other side of the Atlantic.

In 2000, the School of Aeronautics and Astronautics of the legendary MIT launched the CDIO (Conceive, design, implement&operate) initiative because the existence of a gap between the needs of the industry and what was taught in universities was detected. Other MIT centers and other universities around the world soon joined this initiative.

³ **Oslo Manual:** publication of the Organization for Economic Cooperation and Development (OECD) with the title "Measurement of Scientific and Technological Activities", which is an important reference for the analysis and collection of data on technological innovation. Its first version was published in 1997, and the third in 2005.

⁶ **Bogotá Manual:** Latin American version that establishes a reference for technological innovation, which responds to parameters specific to the region, considering professions and trades that are not for developed countries.



Figura 1- Resultados de la iniciativa CDIO – Fuente ABET. (2012)

It was clear that the old study plans were missing something; almost all the time was dedicated to studying the content, including carrying out practical work, but work on the students' personal and interpersonal skills was neglected. The objective of this initiative was to improve these capabilities without diminishing the learning of discipline-specific competencies.

The CDIO initiative carried out a review of the quality standards of MIT and other universities, of large companies - such as Boeing - and of widely recognized quality criteria - such as ABET, (2012) -. A large survey was also carried out among industry engineers, professors, former students and national and international quality agencies to find out their opinion on the “standard” competencies that graduates should have.

According to Santos Baranda (2005), the term competence began to be used in the United States at the end of the 1950s, mainly by theorists belonging to the Cognitive Psychology movement.

More precisely, Eneas Alvarez, M^a (2003) points out that the term Competence, in a professional context, was used for the first time by Mc Clelland in 1973, when referring to the excellence of the manager and the professional person in a given job. ; It can be considered, therefore, a relatively recent term, but as we will see when interrelating with related terms, such as “*Innovation*”, the natural conception of what “*it is to be competent*” has already been implicitly declared (or at least thought of) for a long time. before, between the end of the 19th

century and the beginning of the 20th. Therefore, it is not worth trying to establish a starting point for the moment, although they are clues that can help clarify the interrelationships, and that is sufficient for the objectives of this work.

This is summarized by García-San Pedro, M. (2009) by stating that there are concepts very close to the term competence, which should not lead to confusion, and specifies that the recognition of these differences can be consulted in authors such as Tobón (2004) and Fernández -Salinero, C. (2006), which consider expressions such as: professional qualifications, abilities, skills, abilities and attitudes, but at the same time specifies that analogous situations occur with other concepts, which may be related to competence, but which are not are synonymous with it, stating, for example, that *"... aptitudes are the capabilities and dispositions for good performance, but they do not necessarily refer to achievement or effective realization in a given situation, that is, they have a potential dimension."* García-San Pedro, M. (2009:13).

For his part, Tejada (1999:1) suggests that the conceptualization of competencies must consider:

1. The concept of competencies involves a whole set of combined, coordinated and integrated knowledge, procedures and attitudes.
2. Competencies are only definable in action
3. The experience appears inescapable
4. Context is key

That is, competence implies mastery, possession of abilities without which it is impossible to become competent. However, "being capable" does not mean the same as

"be competent." Competencies cannot be reduced to either *"knowing"* or *"knowing how to do"* but to the mobilization of these resources. In the dynamic process of building competencies, the training process is not enough. The concept of competence is inseparable from the notion of development or continuous learning.

Obviously, just a few steps are taken, and little by little we are entering the terminological crossroads. If we continue down that path, we would lose sight of our goal.

How many interesting definitions and opinions we are failing to consider!

But only for the moment, so as not to lose the thread of the story. We will leave something no less important for the next chapter.

1.3 The Tuning Project. Materialization of a dream born in Bologna

While the CDIO initiative was launched in the US, Europe did so following similar steps, starting from the Bologna Declaration (which according to Campos, D. (2011) included the Magna Carta of European Universities, signed in Bologna in September 1988; the Lisbon Declarations of April 1997 and the Sorbonne Declaration of May 1998, among others) through the Tuning project (Tuning Project, 2012; González, J. and Wagenaar, R., 2003), led by the University of Deusto.

More than 100 European universities initially participated in the Tuning project. The project focuses on the design of a methodology to promote understanding of the curriculum and make it comparable between universities.

The reason for the name Tuning

As described in González, J. and Wagenaar, R. (2003), the name Tuning for the project *“reflects the idea that universities are not seeking harmonization of their programs or any other kind of unified, normative or European curriculum.”* definitive, but simply points of agreement, convergence, and mutual understanding (...) In the project, tuning, in gerund, is used to make it clear that it is something that is in process and that it always will be, *since education must be in dialogue with social needs and this is an open and dynamic process.”*

In a manner analogous to the process developed in CDIO to identify generic competencies, an extensive investigation was carried out that determined the preparation of a list of thirty generic competencies classified into three categories: instrumental (10), interpersonal (8) and systemic (12).

The in-depth development of each of the competencies was edited as part of the report that was later translated into Spanish (Villa, A. & Poblete, M. 2007), and which is currently the reference book for all centers that wish to introduce generic competencies in their study plans.

Also in this first phase, the concept of ECTS was defined, as a unit of measurement of the student's work, based on a system of transfer and accumulation of credits, and different aspects of teaching and learning, evaluation, performance and quality were detailed. . (Sánchez, F. et al, 2012).

It is worth mentioning, moving forward chronologically to the facts, that the results achieved by the Tuning project, through its application phases, impacted the academic field of many countries, outside the EHEA context, most especially in Latin America, with Chile at the forefront. head, giving rise to the emergence of the Tuning-Latin America Project, also known as Tuning AL or Alfa Tuning Project, as it is financially supported by the European Alfa program.

Although the term “*competence*” is still under construction, generic competencies can be outlined or defined that are shared in all professions and that begin in training and continue throughout the course of the discipline as well as professional life (Durrieu , M.L and Escobar, A, 2011).

The reference article is a good example for those interested in having an overview of the implementation of a competency-based system. From this text the following recommendation from the authors is extracted: *“To encourage and integrate the development of competence throughout the curriculum, it is advisable that the center appoint a coordinator who has a global vision of how work is done in the plan. of studies and help the subject coordinators to design the activities.* (Farré, R. et al (2012:1).

In essence, the article proposes a methodology for the implementation and evaluation of the training process, starting from the conception of the competency map of a degree, internally structured in dimensions and these in turn in three levels of objectives, clearly identifying whether the objectives of a certain level coincide with those of other dimensions totally or partially (Fermin, A. et al (2012).

With this we close this first terminological approach to the topic, which although it has not been as exhaustive as we would like, we think it is enough to prepare the reader, since they will need it to refine their understanding of the contents that follow.

Professional competencies as complex processes

2.1 Complex processes. Conceptualization

The reader should have noticed that, in some of the examples presented, there are differences, most of them subtle, between the various ways of understanding what is identified as “competency”, not only from country to country, but also within the countries themselves. According to Tobón, S. (2007), there are also different stages of maturity in relation to the identification, standardization and certification of competencies and, consequently, in relation to competency-based training.

This is because a large part of Tobón's works, substantially holistic in terms of the subject they deal with, are based on conceptions based on theories of Complex Thought and on the work of one of its emblematic figures, the philosopher Edgar Morín, which a reader interested in the subject can consult in Tobón, S (2007a). Unfortunately, it is not possible to do so in these limited pages, but it is possible to recommend their study in the main sources, which are precisely the works of Tobón and Morín.

We have already left pending certain aspects that could not be dealt with for the moment, precisely because it was necessary to introduce concepts related to complex thinking.

We left out of consideration the proposals given by Tobón (2004), on the methodology of conceptual mapping. This methodology consists of studying a concept in depth in order to systematize the existing information about it, to build the missing aspects based on the existing information, to understand it and to communicate it clearly to the academic community. It is applied to theories, approaches and methodologies. (Tobón, S. et al. (2015).

We also exclude, for example, the following criteria for typification of competencies, made by Gonzi and Athnasou (1996):

1. Competencies through the tasks performed
2. Competencies in terms of personal attributes.
3. Competencies from a holistic perspective

In accordance with the objectives of this paper, it is worth considering that the holistic approach approaches competencies from a broader and more complex viewpoint.

However, it should be considered that the holistic conception itself opens up a range of trends, which obliges those interested in the subject to take into account different criteria, before developing their own vision. Eneas Alvarez (2003), in his doctoral thesis, focused on Intercultural Competences, groups the following five main trends:

- a) Alex (1991)
- b) Le Boterg (1991)
- c) Bunk (1994)
- d) Instituto per lo Svilupodella Formazione Professionale dei Lavoratori ISFOL, (1995).
- e) Echeverría (1996)

We recommend a review of the Italian model, which establishes in itself a conception of competencies in a model defined as a set of technical-specific knowledge, which is articulated in three large blocks of competencies: Basic competencies, technical-professional competencies and competencies. transversal (ISFOL, 1995).

If we look at the date and characteristics of the model, we can see that before 1995, these groups had been working on the conception that later materialized in Tuning.

If we consider that in recent years the evolutionary diversity of the concept has been limited to variations around the essence, then we find a complementary source of consultation in Navío Gámez, A (2000).

Although it may seem incredible, there are branches of the tree that we have not yet considered in this account, or to be more precise, we have had to prune because we would lose the objective of the work, focused on criticism, as it draws attention to an absence, a complement, a similarity, an alert; but never pretend to replace them.

For example, for a truly holistic analysis, it must simultaneously be taken into account that the development of research in this field has allowed the generation of two groups of approaches, based on two fundamental dimensions:

- the cosmovision, for the understanding of competencies, where training for competitiveness and training for 21st century citizenship is found;
- and a second approach according to its structural-functional dimension, where the reductionist/behaviorist approach and the integrative/contextualist approach are found. (Castellanos Simóns, 2003: 5-8).

In any case, it is recommended to take into account the following criteria (Angeli, 1994: 45):

“The competencies must be written and expressed in terms of observable and measurable behaviors, which present responses and behaviors that are easily recognizable by people of any educational or qualification level, and that their very name is fully indicative of the type of behavioral activity.”, mental or emotional that the person who possesses them must develop.”

⁸Relating to the ability to generate the greatest consumer satisfaction, fixed at a price; or the ability to be able to offer a lower price, given a certain quality. Regarding the loss of competitiveness, it generally describes a situation of increased production costs (Wikipedia, 2016).

2.2 The concept of professional competences, seen as a complex process

It is worth noting that Tobón is an author of extensive bibliography on the subject, a work to which some references are dedicated in the following pages.

In accordance with the above, multiple definitions of competencies have been established, but all of them have problems due to their reductionism or lack of specificity with other concepts.

It is essential, therefore, that the authors assume a definition capable of satisfying the aspects that have been partially identified, in order to then be able to present the remaining contents of the chapter.

Based on what has been expressed, we assume the definition given by Sergio Tobón, who proposes defining the competencies as:

“Complex performance processes with suitability in certain contexts, integrating different knowledge (knowing how to be, knowing how to

do, knowing how to know and knowing how to live together), to carry out activities and/or solve problems with a sense of challenge, motivation, flexibility, creativity, understanding and entrepreneurship. , within a perspective of metacognitive processing, continuous improvement and ethical commitment, with the goal of contributing to personal development, the construction and strengthening of the social fabric, the continuous search for sustainable economic-business development, and the care and protection of the environment and of living species "Tobón, S. (2007, 2007a:17).

It is a definition that has deserved to be referenced in dozens of articles, theses and books, and that Tobón himself reproduces in subsequent works, since according to him this definition contemplates essential aspects in the concept of competencies, from the complex approach: processes ,complexity, performance, appropriateness, metacognition and ethics; and also points out that this means that, in each competence, an analysis of these six central aspects is carried out to guide learning and evaluation, which has implications in didactics, as well as in evaluation strategies and instruments Tobón, S. (2007a:17).

"A detailed analysis of this concept and the assessment of its components is presented by Tabón in a summary table, finally pointing out that "Competencies are an approach to education and not a pedagogical model, since they do not intend to be an ideal representation of the entire educational process. (...) competencies are an approach because they only focus on certain conceptual and methodological aspects of education and the management of human talent" (Tobon, S. (2007a:18).

Once again it is difficult to understand that among the many studies consulted, most of them well documented, an aspect as important for the analysis, as the complex approach seems to be, is not even mentioned.

Considering all of the above and although the general vision that we propose to provide remains limited, it is feasible to identify certain common elements around professional competencies. According to Santos Baranda, J. (2005a), it is common to find the following:

- The relationship between performance and competence.
- The relationship between competence and activity in its three components: cognitive, practical and axiological activity.
- The identification of competence as a capacity based on its conception in the development of personality.
- The relationship between competence and the solution of problems related to the profession.
- Competence as a psychological configuration and the relationship between cognitive and affective processes in its formation and development.
- Its relationship with the demands of the environment.

Although the set can be expanded, what is interesting to highlight for the moment is the convergence towards a competition model that to a certain extent is the interrelation of all this, or at least holistically it is.

Given the above, which to some extent seals the different parts, which like roots of a tree have been generated and emerging through this study, everything indicates that there are three aspects, which are always present, which cannot be ignored at the moment. time to conceptualize in this field of established knowledge: its polysemic character, its complex character and the need to fraternize and link, in the professional training process, the generic with the specific.

It is recognized that such a purpose is not something that can be achieved by simple empathy between branches or disciplines that share common attitudinal processes. It is probably the Spanish universities that have made the most progress in this direction. Although on the one hand there is extensive experience in carrying out this process of working on and evaluating specific competencies, since in the end it is what has always been done, the same does not happen with generic competencies (Farré, R. et al 2012).

Many of the teachers of Bachelor's and Master's studies have little or no experience with generic competencies, and it is difficult for them to work on

them in their subjects, generally of a "technical" type, so that students integrate them during the training process.

The reference article is a good example for those interested in having an overview of the implementation of a competency-based system. From this text the following recommendation from the authors is extracted:

"To encourage and integrate the development of competence throughout the curriculum, it is advisable for the center to appoint a coordinator who has a global vision of how the curriculum is worked and helps the subject coordinators to design the activities". (Farré, R. et al (2012:1).

In essence, the article proposes a methodology for the implementation and evaluation of the training process, which is based on the conception of the competency map of a degree, internally structured in dimensions and these in turn in three levels of objectives, clearly identifying whether the objectives of a certain level coincide with those of other dimensions totally or partially (Farré, R. et al (2012).

Such a conception, aided by *"Teaching Guides"* that make it possible to trace the trace of each competence throughout the entire degree, constitutes a powerful tool that specialists in curricular planning should not ignore. These guides have in turn been prepared following the guidelines formulated in manuals such as the one developed at the Polytechnic University of Cartagena (Herrero, R and Pérez, J., 2012), conceived by the teaching teams during the 2009/10 academic year, in which framework of the Teaching Teams project of the Vice-Rector's Office for Academic Organization, of the Polytechnic University of Cartagena.

For example, a Teaching Guide for teaching Engineering Graphics can be seen in (Cavas, F., 2015/16) where a real example of teaching planning based on competencies is shown at the Technological University of Cartagena. Due to its possible interest for teachers of various specialties, whether or not they work in competency-based training, this guide is included in Annex II that appears at the end of the work.

Competencies, performances, innovation and invention

As already mentioned, the polysemic nature present in the object of study determines that new ideas emerge at every step, certain terminological aspects pending clarification, which usually create confusion when it comes to professional skills, etc.

One of them is precisely the fact that similarities are usually established, as synonyms, when the terms competence and performance are used interchangeably; or when there is a correspondence that should be seen as more direct, but commonly does not appear that way in the literature, as is the case between competencies and innovation, which are seen as separate, if not divorced, objects of knowledge.

3.1 Relationship between competencies and performances

Without pretensions to documenting the term, the first thing that deserves clarification is to specify that “*performance*”, in itself, is not an object of study. If we go to conventional dictionaries, generally the definition is very poor and very far from the context in which we are.

A Wikipedia-style dictionary could be a little more explicit. For example, the meaning is around definitions such as the following: “*Integrating concept of the set of behaviors and results obtained by an employee in a certain period.*” (Wikipedia, 2016).

But we cannot ignore that when saying “*integrator of the set of behavior and results*”, that is very close to what we have highlighted in the preceding pages when identifying the elements present in the conceptualization of competencies, and in fact this duality is ratified when the expression “*performance by competencies*” is used.

It then means that it is wrong to establish a duality between both terms, even though they are directly related. And that relationship comes from the need to be able to measure, evaluate, and provide an exact and reliable description of

the way in which the employee carries out his or her activity in the workplace (Matías Sales, 2002).

A specialist on the subject like Varela (2013), prefers to consider that, depending on the field in which it is used, the term "*performance*" can have several meanings. In the business context when we talk about performance from a resource management point of view humans. "*Reference is made to behaviors or actions of employees that allow a company to achieve results*"; That is, "performance" is any type of behavioral contribution that promotes positive results for the organization (Varela, O: s/p).

However, from the works consulted it can be inferred that what is concrete is that the true meaning of the term is assumed when talking about Performance Evaluation..

3.2 Performance evaluation

What is meant by performance evaluation?

According to Lavanda, D. (2005:3), the analysis of the different concepts consulted to make one's own judgment suggests that the essence of any Performance Evaluation system "*is to make an assessment that is as objective as possible about the performance. and results obtained by the person in the daily performance of their work.*"

Therefore, we are talking about the interaction between employer and employee, and it generally materializes in an instrument or tool that is applied in certain circumstances and based on objectives that both parties know and accept. Ultimately, they simultaneously allow us to obtain information that can be expressed in degrees of competence of a person to perform a job.

What a coincidence! What are we talking about, being competent or having performance? – Curious similarity...

It seems the same, but it is not the same. Here it is worth returning to the old saying that laconically says: "*Being an Anvil is not the same as being a Hammer*"... Being evaluated is not the same as being an evaluator.

Even if it is simply out of curiosity, it is good to include here a definition of competencies, which seems made for the occasion: "In other words,

competency is the ability to perform well in complex and authentic contexts. It is based on the integration and activation of knowledge, abilities, skills, attitudes and values" (Espinosa, M^a Rocío, 2016: 1). It should be noted that this is a very popular concept, since it is literally reproduced by various authors. But we analyze it, in addition to the authorship, because it is appropriate at this moment.

However, in this case, the essence of the definition does not reveal an important fact, and that is that, when talking about "good performance", it is necessary to make it clear that it is a feedback process, between employer and employee.

According to Matías Sales (2002), performance evaluation constitutes the process by which the overall performance of the employee is estimated; and it is normal for most employees to seek feedback on the way they carry out their activities; and correspondingly, their counterpart, the people who are in charge of managing other employees, must evaluate individual performance to decide the actions they should take.

For performance specialists, it is clear that informal evaluations, based on daily work, are necessary but insufficient. By having systematic feedback control, the personnel department can identify problems in time. According to Matías Sales (2009:1), "A good evaluation system can also identify problems in the human resources information system"; and also comments that people who perform insufficiently may show flaws in the company's selection, orientation and training processes.

In general, a good performance evaluation system is considered indispensable, in addition to providing advantages such as: feedback helps improve performance; It can also help identify who deserves to receive recognition and raises; evidences the need for training for certain jobs, when the need becomes evident due to insufficient employee performance; and insufficient performance can indicate errors in the conception of the job, among other important aspects (Matías Sales, 2009).

On the other hand, performance usually faces external challenges, such as family, health, finances, etc., which can be identified in the evaluations. Nor can it be ignored that performance evaluation always combines objective and

subjective factors, and therefore the Evaluation systems must be directly related to the position and be practical and reliable. They need to have completely verifiable measurement levels or standards.

Furthermore, performance evaluation is in itself a specialty, and it is not the purpose of this work to expand on it. We simply intend to raise attention to its importance, and highlight the similarities and differences, as well as the primary aspects in an approach to the subject.

3.3 Competences and innovation

Once again a polysemic situation is present, this time around the concept of innovation.

In an interesting text from the OEI, proposed for debate, this reality is characterized by stating that *“The literature dedicated to the definition and delimitation of innovation is extremely overwhelming”* (Ciencia, 2012: 62).

In the reference text, when establishing the conceptualization, it is proposed that one current focuses on defining innovation in a restrictive way, limiting its analysis to the institutions and mechanisms that promote only technological innovation (Nelson and Rosenberg, 1993); while another current values it as the result of a process that includes its introduction, dissemination and use, linking it with the development of learning capabilities, as the authentic driving force of current economic processes (Lundvall, 2007).

It is curious, however, that in a work that assumes an open position on the subject, and focuses interest on the socio-cultural approach, the Oslo and Bogotá Manuals are only mentioned on one occasion. In our opinion, when addresses the analysis of the R&D problem, reference documents cannot be undervalued, especially when conceptualizing competencies on a global scale.

An extensive commentary on this problem is dedicated in (Fano, F. 2012: s/p), which culminates with a statement, which comes in handy to close the matter: *“Not even the ISO-UNE 166000 certification is useful. to clarify the issue a lot, as all of us who have considered it when considering an innovation management system have discovered. Certification does not go into the depths of what it means to innovate”*.

3.3.1 Definition of innovation according to the Oslo Manual

However, established definitions cannot be dispensed with, and in that sense we must consider the OSLO Manual, which in its 3rd edition defines innovation as *“the introduction of a new, or significantly improved, product (or service), of a process, a new marketing method or a new organizational method, in the internal practices of the company, the organization of the workplace or external relations”* (OECD, 2005:56).

It is also significant that, in general, the skills-innovation link does not have greater emphasis in the specialized literature, when the relationship is practically tacit, since in some way it does not seem viable for innovation to occur where there is no competition.

This interdependence is commented on by Valdivia Moreno, when she highlights that *“Innovation is the key element that explains competitiveness,”* also indicating that innovation and competitiveness go hand in hand. The question is: can you be competitive without being innovative?

It is typical that in "systems" of continuous improvement, moments of saturated market occur, where innovation becomes an essential process to achieve competitiveness, *"because the efforts to improve have reached their limit and are no longer sufficient to continue." forward*. (Valdivia Moreno, V. 2014: s/p).

Once again, as authors, we find ourselves at a crossroads. On the one hand, we must not lose sight of the stated objective of this work; and on the other hand, open as much as possible new points of diversification of paths, in which a term branches into applications or meanings. To be honest, it is worth recognizing that at certain moments, in which the searches carried out by the authors have not been sufficiently satisfactory, we have felt the impression that we are missing something to identify...

For example, around the term innovation, one of the main conceptual branches delves into the paths of Technological Innovation, which in turn is directly related to the Methodology of Technological Research; the latter is the discipline that fosters the natural link between the three fields: skills – Innovation – Technology – and others.

And indeed, it is not possible to ignore a branch of extreme importance...

3.3.2 Schumpeter's conception of innovation

The most surprising thing is that a classic like Joseph Schumpeter (1883-1950), notable Austrian economist, considered by consensus to be the father of Technological Innovation as a science, defined technological innovation as *"the introduction of new products and services, new processes, new sources of supply and changes in the industrial organization, continuously, and oriented to the client, consumer or user"* (Mackinlay, 2007: s/p).

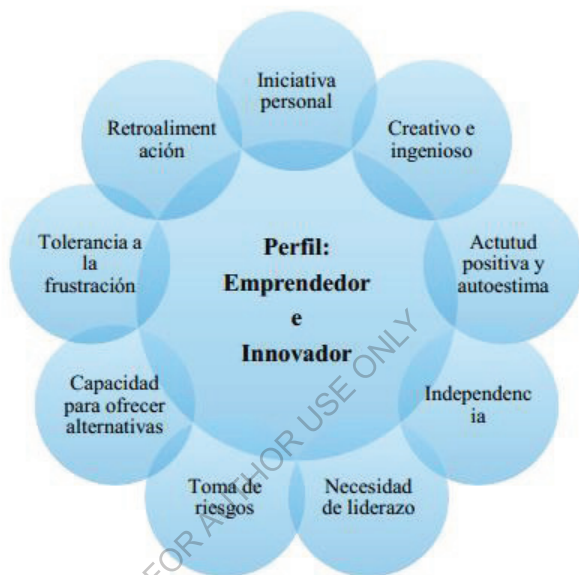
Such a vision is decades ahead of a conceptual understanding of innovation, which was only established in specialized literature from the third version of the OSLO Manual (OECD, 2005) and its counterpart, the Bogotá Manual (Jaramillo, H., Lugones, G., and Salazar, M, 2001), when services were included as a feasible source of technological innovation.

In addition to producing an extensive theoretical work in the context of Economics and Innovation, Schumpeter is widely cited for having popularized the concept of Creative Destruction, by the German sociologist Werner Sombart, in his book *Capitalism, Socialism and Democracy* (Schumpeter, J. 1942). , directly associated with the concept of "The innovative entrepreneur". which Schumpeter defines by saying that *"The innovator is not an inventor. The latter is generally a genius, an amateur or professional technician/scientist. The entrepreneur creates markets for the inventions of geniuses."*(Mackinlay, 2007: s/p).

However, although the references to Schumpeter's work and life are extensive on the Internet, and his interpretation of the concept of Creative Destruction, as a way of describing the process of transformation that accompanies innovations, deserves an analysis beyond the context of the economic thought in which it is generally framed, in the search carried out we did not find its name referenced among the bibliography of hundreds of articles on competencies that can be consulted on the world wide web, taking this as a thermometer capable of showing to what extent it is a subjective or real appreciation.

If we limit ourselves to the context of economics, it is recognized that Schumpeter was the one who introduced the concept of innovation in his *"theory of innovations"* and to a large extent his classification, which establishes 5 types of innovation, was a reference for all subsequent development. in this matter (Schumpeter, J, 1961).

A good example that allows us to show the tacit link that exists between Innovation and competencies is found in the following diagram in Figure 2, taken from (Montoya Herrera, M. (n/d), which in our opinion evidences in a quite natural and objective way the relationship between the terms Competencies and Innovation.



Fuente: Elaboración propia con base en artículos de divulgación científica.

(Tomada de Montoya Herrera, M. (n/d)

Figure 2.- Model that implicitly relates skills to innovation.

The similarity between the elements that are interrelated in this proposal is interesting, to form a possible profile of the entrepreneurial and innovative individual, which at first glance can be found in lists of generic competencies and also in the specific ones, of different professions. Even if the central circle label is hidden from view, the model could be valid for identifying other professional profiles.

3.4 Innovation and creativity

Based on these criteria, it is appropriate to assume a conceptualization that makes it possible to form a convergent theoretical framework, which obviously

will not be the sum or intersection of independent theoretical frameworks, but rather an approach that interrelates and blurs the limits, making it possible to work on a theoretical support in which fields that are not incompatible at all intermingle.

The word Innovation is often confused with Creativity. According to Art Fry, from the 3M company, widely cited on the Internet, for being the creator of Post-its, *“the little yellow pieces of paper”* considered one of the most recognized inventions in history, the difference lies in that: (Gil Gonzalo, O. 2013).

- Creativity: is a new idea for a product or process, or a new pattern for doing something.
- Innovation: is where people change to a new practice or use a new product.

An Idea is not in itself an Innovation. *“There is an innovation process that starts from a creative idea, converts it into a process/product and takes it to the market successfully. That is when we talk about Innovation.”* (Gil Gonzalo, O. 2013:103). Expanding in details on the same aspect, the aforementioned author mentions 13 different types of Innovation (Gil Gonzalo, O. 2013:104). But the most interesting thing, for our objective, is that in the aforementioned article, INNOVATION is tacitly recognized as an important competence for the labor market. It is not something new, but it is significant because of the way it is focused.

According to this author, *“innovation competence implies the ability to generate ideas, develop them, evaluate them with feasibility criteria and implement them to achieve solutions to problems or improvements in any professional field”* (Gil Gonzalo, O. 2013:104).

In the following pages of the aforementioned article, the author identifies 7 indicators and 3 components associated with this competence, among other aspects of interest, that deserve the attention of readers interested in delving deeper into the topic.

In summary, for many people not familiar with these topics, the term Innovation implies creation, invention or improvement of tangible objects, and

one does not always see its implications on the non-tangible, such as processes, much less visualize it as a Desirable competence in training, even generic, due to its scope, which involves diverse professions.

Such a simplistic way of assessing the matter can be exemplified by seeing it in the flow of time, in the technological evolution of an object, such as a simple watch. For the average person, the sequence of development could be highlighted according to the following historical-logical scheme:

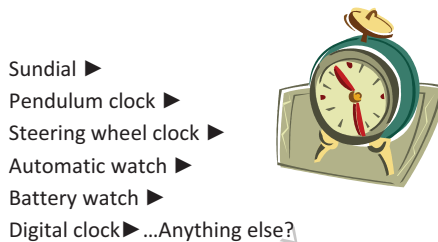


Figure 3- Innovation process since the invention of the clock

How many innovative variants have we missed in this a priori list?

The issue is not so simple, although it seems that similar criteria are seen too frequently, especially in the press in general, commentators who refer to innovations without having full knowledge of what this means and implies.

Without going into details, since it is not the appropriate space, today it is recognized that innovation involves identifying that there are objects or elements on which action is taken: products, services, procedures and even methods; and associated with these are qualities such as novelty, improvement, usefulness or renewal, from the point of view of markets or social units (Guato, M. 2012). That is to say, the main sources of innovation are not exactly tangible, but rather processes and services, although this was not always considered this way.

If we turn again to the OSLO Manual (OECD, 2005), as we already know, one of the main reference guides on technological innovation, only from the third version onwards are some indicators not considered in the 2nd version, specific for organizational and service innovations.

According to this 3rd version of OSLO, four types of innovations are distinguished: product innovation, process innovation, marketing innovations and organizational innovations. But such classification was initially adjusted to the interests of a group of nations, essentially from the first world, ignoring for the moment what is related to services.

Complementing this document, but adjusted to the interests of Latin American countries, the Bogota Manual arises (Malaver, F. and Vargas, M, 2004), in which the regional factors that support technological and social development are reflected in its indicators.

According to these authors, and thinking according to the Latin American context, *“Technological innovation consists of products and/or processes implemented for the first time in the market and that are technologically new or significantly improved”*, clarifying below that *“A technological innovation was implemented if, in the case of the product, it has been introduced into the market and, in the case of the process, it has been used in the production process”* (Malaver, F. and Vargas, M, 2004:30)

If attention is focused on Innovation, the link with the competencies that we have been pointing out does not seem to be anywhere, and in fact it is significant that a bibliographic review of authors in both fields barely reports duality of names.

Now, if we go to the specific actions that are declared so that there is the presence of innovations, it is possible to find situations like the following.

According to Guato, M. (2012), professionals who dedicate themselves, or intend to do so, to activities related to innovation, need to equip themselves with the skills that allow them to:

1. Achieve the ability to identify the opportunities and challenges that technological development and globalization present to countries, nuanced by the different levels of social and economic development, cultural and political particularities, in addition to the restrictions of current local legislation.
2. Know how they influence and the effects of innovation and creativity in the formation of competitive advantages of organizations.
3. Be able to implement the basic innovation management criteria in practice.

4. Develop personal skills to participate positively in organizational change processes.

That is to say, there is no real epistemological divorce, but it seems as if there were, as if two specialists sat working at a library table, frequently seeing each other's faces, sitting almost face to face, reading the same books or similar, and finally met one day, almost by chance, when they met in the conference room, interested in seeing and participating in the analysis of the same presentation...

In short, they are just examples in which it is possible to find the connection and at the same time the distancing that is observed in the literature that deals with the subject. We do not doubt that our own study is leaving out important works, and that in some of them this problem has been treated with great rigor. In that case, it would be like proving absurdly that we are right in stating that there is a real link between skills and innovation

The scheme, formed from a typical representation of the competency-based training model (Fernández, D and Cavas, F, 2013) that is used in Spanish universities, illustrates in a very simple way the essence of that relationship..

It is true that in this representation Innovation is seen as an external result of the competencies, and not as one of them, but that is not the internal reading of the model, which functions as a process, innovation being the result of that process, when Within it, a competency formation process has occurred, which includes the Innovation competency, and therefore there is potentially in this process the possibility of generating actions that, under the market requirements, could produce a Technological Innovation, identifiable in the terms provided for in some of the reference guides (manuals), which are not only those of OSLO or Bogotá



Figure 4- Chain that relates the formation of skills to technological innovation

Para más información ver también: **Manual de Frascati** (OCDE, 2002), para encuestas de investigación y desarrollo experimental; **Manual de Lisboa** (RICYT, 2009), sobre pautas para la interpretación de los datos estadísticos y la construcción de indicadores referidos a la transición de Iberoamérica hacia la Sociedad de la Información; y el **Manual de Santiago**, (RICYT, 2007).

3.5 Invention and innovation: the chicken or the egg?

- A work, in addition to those already mentioned, that in our opinion brings one closer to the other, is García-Córdoba, F. (2005) where the link is made explicit, given that, as a textbook, it goes beyond the content. academic, and presents interesting illustrations that allow a clearer understanding of the ideas.
- There are so many aspects of that work that are worth referring to here, that since it is impossible to do so, it is preferable to return to the author's own suggestions, to concentrate attention on specific aspects, depending on the interests of the reader.
- Thus, after giving suggestions on the basic chapters of the work, which we also recommend studying, García Córdoba (2005:14-15) suggests that:
- If you want to create a new object, it is recommended to examine:

- Chap. 4. The invention.
- Chap. 8. Creativity.
- If what you want is to develop an idea, to the point where it is ready for implementation, study the:
 - Chap. 5. The design
- If you seek to implement the idea contained in a project, in a concrete reality:
 - Chap. 6. Innovation: the concept.
 - Chap. 7. Innovation: the process.
- If you want to carry out an intervention in a specific reality and especially if people are involved, it is essential to read:
 - Chap. 17. The change

Although these simple suggestions already give a clear idea about the structural sequence and the logic of reasoning that the author offers regarding these contents, the differentiation established between concepts such as invention and innovation is also significant. According to this author, the word invention applies to three elements: an idea, a product, and the process through which the previous two are achieved. Hence, he also asserts that *“from the appearance of the invention to its application and commercial development, efforts will not cease to evolve until it can be considered an innovation”* (García Córdoba, F. (2005:126).

A few pages later, when conceptually establishing innovation, it assumes the concept given by Benavides, C. (1998), where it is declared that innovation is the *“Process integrated by the set of activities registered in a certain time and place, which lead to introducing with success in the market an idea in the form of: new products, processes, services, techniques, management and organization, etc. It is a different way of doing things, the product of new combinations, which significantly influences the economy and is generally linked to the field of production”* (García Córdoba, F. (2005:182), which curiously considers elements that were only incorporated into the OSLO Manual many years later.

Closing this trilogy of aspects, García Córdoba (idem: 170) includes an illustration that speaks for itself, showing the logical sequence that links the three components: Invention – Design – Innovation.

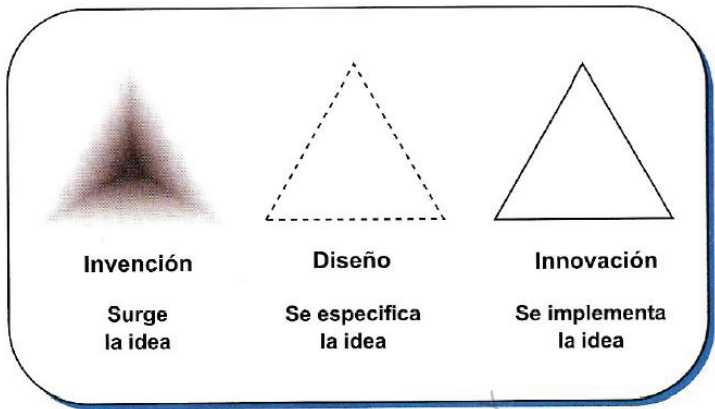


Figura 5 – Diferencias conceptuales entre invención, diseño e innovación
(García Córdoba, F. (2005:170)

This suggestive representation of such a complex process allows us to return to the original problem, and ask ourselves: Is it possible to successfully move through this process, without the involvement of the Professional Competence of the human resources involved in it?

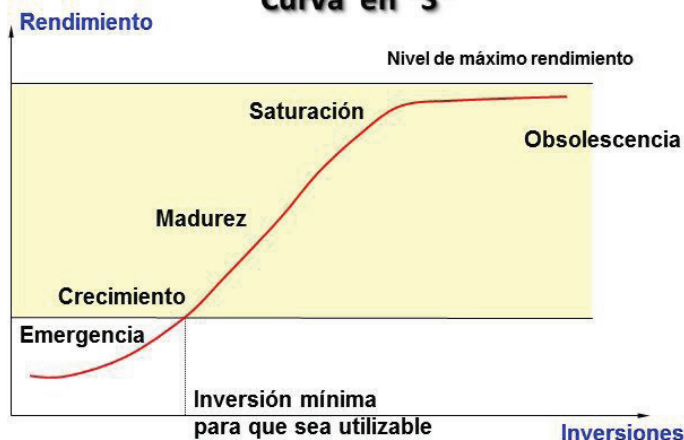
A similar question could be asked for a process in regression (technological development according to the S curve), and especially when the product (or company) enters the obsolescence phase, as shown in the figure 6.

Who determines who? Does the lack of competition among un renewed personnel, especially for innovation, lead to obsolescence; Or by natural law of the process itself, a company in a period of instability for change, does not manage to emerge from the obsolescence phase, and that determines a general reduction in the performance of the workforce, produced for multifactorial reasons?

Good questions for in-depth research, that only specialists in the field could clarify for us.

Desarrollo de una tecnología

Curva en "S"



Fuente:

GESTIÓN DE LA TECNOLOGÍA

<http://www.getec.etsit.upm.es/docencia/gtecnologica/>

Figure 6 – Development of a Technology according to the S curve.

3.6 Competences vs innovation

The authors not having concrete, clarifying answers, we choose to leave room for non-academic thought, which still has its component of participation in human work.

Probably in situations like this it is possible to remember, more than in any other, the mythical phrase of Albert Von SzentGyorgyi, discoverer of vitamin C, about what it means to discover:

"Discovery consists of seeing what everyone has seen and thinking what no one has thought" (Jaim Etcheverry, G. 2006: 175).

Other references to the same quote can be found in (von Oech, R. 1998, Stalman, A., 2016). The quote has been taken up by several authors, at different times.

It might be thought that the topic "discovery" is not directly linked to professional skills, but from our point of view and taking into account the results achieved by great scientists, who dedicated many years to obtain just

one memorable achievement, we think that there is a question that we cannot help but subject it to a crude analysis: Were these discoverers competent in their jobs?

If we stick to the various criteria that we have assessed throughout this study, the almost forced response would be to say NO! In fact, as is known, more than one transcendental discovery for humanity was made as a result of some carelessness or confusion on the part of the researcher himself.

But surely many readers would not accept this conclusion, it would be to deny the importance of research, or of the creation process that occurs, either when a pure scientific discovery occurs, or when it leads to successive processes of innovation, which make it applicable.

That is why a couple of references that refer to great personalities in science, to whom very illuminating phrases on the subject are attributed, may be more appropriate.

In his book "The 10 Faces of Innovation", Tom Kelley (2013) takes up the well-known phrase of Tomás A. Edison, the man who helped bring humanity out of the shadows, who used to say: "I have not failed. I have simply discovered ten thousand alternatives that do not work."

Very ingenious. But the most unexpected thing is that this message from Edison, strictly anti-resilience, because it represents the consummation of the human capacity to face adversity, is used in the press for the most diverse purposes.

Another very interesting point of view is attributed to Einstein and is referenced by several authors, without giving the original source, which generally places it in 1938:

"Galileo formulated the problem of measuring the speed of light, but he did not solve it. The formulation of a problem is often more essential than its solution, which may be just a matter of mathematical or experimental skill. Posing new questions, new possibilities, seeing old problems from a new angle, requires a creative imagination and marks real progress in science." Albert Einstein. 1938. Cited by Guato, M. (2017:s/p).

A few good phrases could be cited related to creativity and innovation, related to famous personalities. But it is more convenient to remember that you also have to be careful in this, because it is common for information to lose its identity. de origen. Thus, an interesting example is given with the following phrase: *"If inspiration comes, let it find me working."* But who is the author of the quote? Dalí? Picasso?... The list of authors is longer.

Finally, it is impossible to conclude this analysis without failing to mention one of those wonderful anecdotes, which, after being cited so much, end up being included in books without their own reliable source. However, in such cases it is well worth "looking to the left", "playing the Swede" or any other popular saying that is equivalent, and instead pay attention to the phrase, without questioning its origin too much.

It is said that on one occasion, when the chemical physicist Faraday was showing his multiple discoveries about electric current, before the leaders of science at that time (Cadavid, A. 2004), they asked him in mockery: what is that use for? electricity? To which the notable experimental physicist responded in turn with a question:

And what is the use of a newly born child?

Reflective look at the Cuban model of professional training

4.1 An approach to the training model of Higher Education in Cuba

Cuban Higher Education has remained until today without joining the international trend of opting for a competency-based training model, and this does not mean that it can be said that its graduates, in general, are not competent to perform the job to which they are assigned. assigned in their postgraduate training period, which lasts 2 years.

In fact, quite the opposite is true: many Cuban professionals, from different branches, are working in more than a hundred countries, either through official collaboration agreements, or on their own, especially graduates of medicine, engineering, designers, industrialists, teachers of various disciplines, coaches of various sports, graduated artists in various specialties and middle technicians of various specialties.

Of course, this is not something extraordinary, it is just that the classic objective training models fell into the decline shown in Figure 1, motivating the transformations that we already know. And Cuba? What lies the difference?

To answer the question, it is convenient to begin by giving some references about the Cuban model.

A general comment in this regard can be found in Horruitiner (2006a), where it is specified that the training model of Cuban higher education has gone from a very high level of specialization, or a narrow profile, to reaching a broad basic training profile. *"It is the result of an entire process of several decades of work, with curricula with very narrow profiles, which led, at a certain moment, to the fact that in Cuba there were about 250 different terminal profiles in the universities"*; highlighting then that *"practically, for every new job need, the university's response was a new career. That was the way to understand how the university met the growing demands of production and services"* (Horruitiner (2006a:2).

This new approach, starting in the 1990s, determined that *“Cuban higher education tilted the balance towards basic training, towards the broad profile, without failing to recognize the importance of the professional also mastering the essential modes of action. of his profession.”*(Horruitiner (2006a:2)

Although it is very subtle, this difference between a narrow profile and a wide profile is the first circumstance that draws a dividing line between competency training and competency training. They are different training models, which go along parallel paths, towards achieving a similar objective. As we will see, while the first focuses on the training of specific skills, the second seeks the training of skills in a transversal way, with the vision set on obtaining basic training.

The first thing to ask yourself then is: Can professional competencies be developed in a training model that tacitly does not identify or declare them?

The question is very direct: If transversal and specific competencies are not declared, and also apparently they are not properly assembled in an interdisciplinary manner, how then is it possible to achieve the formation of such competencies in the graduate?

For Horruitiner, P.(2006:30), *"the training model of a Cuban higher education professional is broad in profile. It is endowed with deep basic training, to provide a primary response in the base link of its profession, by being able to solve with independence and creativity, the most general and frequent problems that arise in their work object."* Note: the emphasis is the authors'.

But what is the base link?

4.2 The concept of “Base link”. Directional axis of the Cuban vocational training model

It is precisely there, in the conception of the Base Link, where the essence of the Cuban model of skills training lies; because that is certainly what it is about, even if it is not tacitly declared.

According to Alvarez de Zayas, author of the term, *“the basic link of the profession is understood to be the job in which the most general and frequent problems inherent to the object of work are manifested, and where the recent graduate must be placed. In the base link, the graduate, given his or her training, has the possibility of performing his or her duties and developing a first*

level of resolution of professional problems. (Álvarez Zayas, C. 1989); (MES, 2016:4). Note: The underlining is the authors'.

That is to say, looking at the various documents and articles written by the Cuban specialists who worked in the Methodological Directorate and the Professional Training Directorate of the Ministry of Higher Education of Cuba, a decade before Bologna they were already working in Cuba on a conception of training that aimed at a certain level of competence, although tacitly it is not a known model, nor does it come from experiences related to Tuning AL, because Tuning simply did not exist then.

And it is not that the very existence of models like the Tuning is unknown. In the same work, Horruitiner states that *“Cuban university students, in all majors, must dedicate an important part of their time to developing professional skills and competencies in different labor, productive and service entities, throughout the country”* (Horruitiner, P. 2006:11).

For a reader unfamiliar with the Cuban model, understanding this process can be complicated. But it could be equivalent, if some adjustments are made to the conceptualization that has been shaped through this work, making room for a *“different”* but not opposing approach.

If we approach a concept of training by competencies typical of Cuban authors, we can accept that *“competences are not something that is assimilated once and for all, rather they are processes that increase their potential based on their sequential advances. They are not formed in one moment of life, but throughout it, both inside and outside the university, being a student or worker who has already graduated. The university, the Educational Teaching Process (PDE), the family, the society and the community in which they live, work and interact are influenced by their educational process. In this sense, the University must offer future professionals the possibility of facing working life with potential and skills that allow them to perform efficiently professionally”* (García, M., Ortiz, T. and González, T, 2013:1).

In the same work, these authors, consistent with the title of their work, highlight that *“Competency-based training in Cuban higher education is therefore an alternative to follow, to achieve the desired development that the country wants and needs.”* (Ibidem:7).

From what has been said, it can be inferred that, although it is not explicitly expressed, reference is being made to a training model that contemplates, for each profession, a mode of action fully identified in the curricular design phase, and declared in the current study plans. .

Such an action model does not respond to absolutely business interests, but is derived from a social order, which is formed from the country's development plans, the technological requirements and the preliminary diagnosis that is carried out during the curriculum design period. , having as a premise that the model is considered to be in continuous improvement, which allows modifications or updates to be introduced from one academic year to another, and from one university to another, modifications that must be previously submitted to different levels of approval (rectoral or ministerial), according to the case.

4.3 Components of the Cuban model of skills training.

It is then worth asking: What components of the Cuban model are those that determine concrete actions that affect the formation of professional skills that are not tacitly declared?

They can be summarized in two essential components: the “*Curriculum Strategies*” and the “*Year Objectives*”.

According to Horruitiner, to fully understand the concept of curricular strategies, you must first be clear about the difference between pedagogical and scientific disciplines.

“Discipline as a pedagogical concept is not exactly the same as scientific discipline. It really goes further. On the scientific level, it has to do only with the logic of said science. The concept of academic discipline, although it also obeys in some way to this logic, also incorporates other aspects that enrich it. For example, there may be disciplines in the career whose objectives respond to ensuring certain modes of action of said professional.” Horruitiner, P. (2006 a:33).

He then states that, the integration of the career as a whole, “*supposes achieving from the disciplines certain knowledge, skills or competencies, typical of the curricular strategies, that go beyond the scope of it as a scientific*

discipline.” (Ibidem:33). Note: The highlighting in bold and underlining is the author's.

According to the base document of the MES, written to guide the work of designing the new “E” Study Plans, the Curricular Strategies serve as an integrative complement, given that they are associated with certain knowledge, skills, values and modes of professional action. declared in the programs of the disciplines, *“and are key in the comprehensive training of students”*, adding then that *“these are contents that cannot be addressed with due depth from a single discipline and require the collaboration of several”* (Ministry of Higher Education, 2016:16).Note: The underlining is the authors'.

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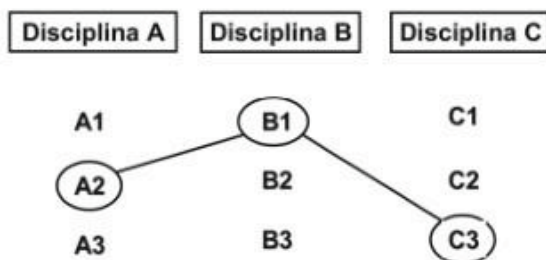


Figure 7. The subject. His double subordination
(Corresponding to figure 4- Horruitiner, P. 2006:36)

It is clear then that the subject plays an essential role in this conception of training, and it will be accentuated when we return to these aspects in the next chapter.

In this regard, Horruitiner states that *"the understanding of teachers is essential to achieve this relationship, because only in this way can each of them have the true space for which they were conceived."* (Horruitiner, P. 2006: 36)

This conception is completed when an element of integration is inserted, which is usually located in the final years of the study plan – although it does not necessarily have to be that way – called the Main Integrating Subject, equivalent to some extent to the integrative projects that exist in universities of many countries, but with a more comprehensive vision.

As Horruitiner states, the main integrating discipline *"is a sui generis discipline, which far from obeying the logic of one or several sciences, responds to that of the profession. It relies on the contributions of the remaining disciplines of the career and assumes them in their integration to respond to the demands of the professional task, ensuring mastery of the essential modes of action of that professional."* (Horruitiner, P. (2006: 37).

According to the governing documents (Ministry of Higher Education, 2003), this integrative conception allows various subjects to be linked in a single discipline, from the first year of the degree (for example, "Introduction to Engineering...") to the last. semester, with the Diploma Project as the closing, but always pointing towards the base link, integrating subjects, curricular strategies, year objectives, and considering that professional training, as a concept, is only completed at the end of the 2-year period of training, and is complemented, in active professional life, with postgraduate improvement.

It is important to highlight that if a specific difference can be pointed out between the Cuban conception and the one present in the European EHEA model, it is that the Cuban model is internally flexible, because the careers admit partial modifications, proposed by the National Career Commissions, which are generally the result of the concept of continuous improvement, mentioned above.

This is possible because there is a dynamic diagnostic process, based on permanent self-evaluation, as one of the characteristics of the model, which in turn meshes with the Social Commission component, to which Cuban higher education must respond, rendering accounts of its management, ultimately, at the level of the National Assembly, which is the State body that determines the destinies of the nation.

Regarding **the Year Objectives**, they can be considered partial goals of objectives that the Year Group must achieve from the curriculum, that is, they are declared in the programs and must be updated each school year if necessary (therefore, they are also flexible). and involve teachers and students in their compliance.

Horruitiner points out that, from the point of view of its design, the academic year is formulated in terms of objectives, its essential direction must be clearly specified, and they must be few and integrative, being the result of the integration of all or some of them. of the subjects taught. In this lies the new quality of this subsystem (Horruitiner, P. 2006a), and it is also specified that Due to its dynamics, unlike the disciplines, the objectives of the years must be reviewed and adapted to the particularities of the students each new year. academic year (Ibidem: 8).

Of course, this is not an exclusivity or novelty of the Cuban model. Under different names, similar components performing equivalent functions exist in universities in many countries.

For example, under the concept of Educational Project, certain teaching-learning processes include actions or tasks that consider the student's self-planning, that is, a calendar of academic and extracurricular activities, which integrate an aspiration or objective to achieve, from individual, but at the same time constitute a collective or group aspiration, although this last aspect does not have the same significance in face-to-face course models as in contemporary models, where each student creates his or her own training tree, and the group nature of teaching no longer plays the role it was once given, especially in higher education.

In Colombia, for example, since the 90s, schools have been working by law on Institutional Educational Projects (PEI), and it is curious to see that, due to their characteristics, such projects presented characteristics and insufficiencies that are still commonly identified in our days.

According to Calvo, G, (1995), it is necessary to emphasize the fact that Institutional Educational Projects are a collective construction that must compromise the intentionality of each of the members of the educational community: teachers, students, parents, the locality in which where the school is located, and even more so: that it is desirable for the PEI to participate in local, municipal and regional development plans.

Such a conception remains valid in current times, except that there is an aspect of the issue that cannot be ignored, and that is that such interaction ultimately takes on an interdisciplinary character, because otherwise we would be in the presence of a model of formation of disciplinary competencies, and therefore without the possibility of achieving the purposes of transversal competencies.

Consequently, such collaboration between different subjects of the same year/semester requires a prior study that makes it possible to demonstrate the interdisciplinary relationships present in the training process, without which the interrelation can only be achieved a priori, based essentially on the experience of teachers, beyond the context of the subject they teach.

Interdisciplinary and transdisciplinary research of a career as the basis of a competency training proposal

5. 1 The terminological problem is repeated

The first thing we must inevitably consider, if an approach to the analysis of the formation of competencies is intended, in a certain higher education model, is to make a transdisciplinary assessment, which highlights the curricular interrelationships; and how these lead or do not lead to the development of certain competencies.

But, the reader may ask, what transdisciplinarity is we talking about?

And here we are once again faced with the epistemological phenomenon of terminological multiplicity, which in the case at hand – the study of the relationships between two or more disciplines – becomes a true set of terms with equivalent meanings, without necessarily. They are synonyms, and when associated with each other they create a true labyrinth, which for some authors can even take on a three-dimensional vision.

According to Fernández de Alaiza, in his study on interdisciplinarity as the basis of a strategy for the improvement of the curricular design of a career in technical sciences, designed specifically for the Cuban model of higher education, he comments that *“due to the diversity of definitions in relation to to interdisciplinarity and the points of view of the different authors who have expressed themselves on it, we can verify the breadth of scope and meaning of the term in question, which has given rise to some recent articles referring to the confusion that is shown in the treatment of this term.”* (Fernández de Alaiza, B. 2000:10).

Noting then that *“the different definitions of the disciplines and the different types of interdisciplinarity proposed by various authors, sometimes contradictory, depending on the essences, interaction and field of application of the disciplines; as well as a set of new definitions such as multidisciplinary, pluridisciplinarity and transdisciplinarity”* (Fernández de Alaiza, B. 2000:10).

The analysis carried out by Perera in this regard also deserves attention. *“The term interdisciplinarity is used indiscriminately and is usually linked to any meeting of different specialists in order to analyze a certain problem, although this does not go beyond mere exchange. This is because, in general, there is no*

clarity regarding its meaning or scope, which undermines the very possibility of achieving some level of interdisciplinarity in the process.” (Perera, F. (2000: s/p).

Perera also expresses his concern about the lack of concrete actions when interdisciplinarity is used as a declaration of principles; *“It is very important and urgent today to move from declarative positions to practical actions. There is an appreciable distance between the declared interdisciplinarity of the curricula and its exercise during their development” (Perera, F. 2000: n/p).*

Finally, to close this presentation of the topic, it is advisable to keep in mind that, according to Rodríguez, N.T. (1997:19) *“disciplinarity and interdisciplinarity are two moments of the same process. It is a two-way movement that can be summarized in a general rule: work separately, work separation, in order to better know the different parts of the universe; work together, work on unification and interaction, in order to decipher the universe to which these parts belong and to be able, in this way, to dominate them more effectively.”*

It is worth noting, to limit the references to this problem to a minimum, that Cuba being a country where numerous authors have carried out and published their studies on curricular design, it has been possible to consult several of these works, and it is confirmed that it is a problem in extremely common in this context.

Therefore, for the purposes of this work, it is sufficient to establish 3 basic levels of curricular interaction, so that the reader can understand the essence of the ideas that you wish to transmit. These levels and scopes are the following:

A) Discipline.

It refers to the relationships that occur within the subjects that make up a discipline, as long as the relationship is real and not simply administrative. For example, between the subjects Differential Calculus and Integral Calculus.

An acceptable definition is C. C. Abet cited in (Apostel, 1975:6) which states that the discipline is *“the specific set of knowledge that can be taught and that has its own antecedents in terms of education, training, procedures, methods and content areas.”*

Furthermore, a new or not yet interrelated study plan can be considered *“disciplinary.”* Simply, since there is no interdisciplinary study, there is no relationship between the various disciplines until that moment.

B) Interdisciplinary

Interdisciplinarity is a term that arises in the university environment as a criticism of the atomization of teaching into isolated and Disconnected (Vizcaino, A and Otero, I. 2005). Generally, it refers to curricular relationships between subject content from two different disciplines, almost always with precedence relationships between one and the other.

According to Jacobs, (1989:8) where interdisciplinarity is interpreted as *“a vision of knowledge and an approach to the curriculum that consciously applies methodology and language from more than one discipline to examine a central theme, issue, problem, topic or experience”*

C) Transdisciplinary

It is the aspect that presents the greatest diversity of conceptualizations or similarities, with respect to the classifications that occur most frequently.

For the purposes of this work, the declaration given in the document Charter of Transdisciplinarity is accepted, given at the First World Congress of Transdisciplinarity, held in the Convent of Arrábida, Portugal, between November 2 and 7, 1994, where in its Article 4 states:

“Transdisciplinarity is complementary to the disciplinary approach, it makes new data emerge from the confrontation of the disciplines that articulate them with each other, and offers us a new vision of nature and reality. Transdisciplinarity does not seek the mastery of many disciplines, but rather the opening of all disciplines to those who cross and transcend them” (Carta, 1994: n/p).

Taken to the terms that best suit the objectives of this work, such a statement allows us to express that transdisciplinarity is understood as the horizontal or vertical transfer of concepts and/or procedures specific to one discipline, in the teaching of subjects from others.

For example, subjects such as Drawing for Engineers, which is generally taught in the first semesters of a Technical Sciences degree and includes the development of skills in the use of automated graphics (CAD), is usually directly applicable in subjects of years higher levels of the degree, such as Designs I and II, Engineering Projects and even the Final Diploma Project.

Taking into account these formal premises, it is possible to present a proposal that, in addition to visualizing details of the formation of competencies in the context of Cuban Higher Education, offers an alternative that supports a general procedure for the development of the transdisciplinary study of any career..

5.2 Starting from scratch: new plan, it is a new

The figure shows a hypothetical example of that interrelation that we have discussed. It belongs to a model for the development of the interdisciplinary study of a career, in which the authors are currently working and integrates disciplines, subjects, ministerial or rector directives, in line with the Curricular Strategies and the Year Objectives.

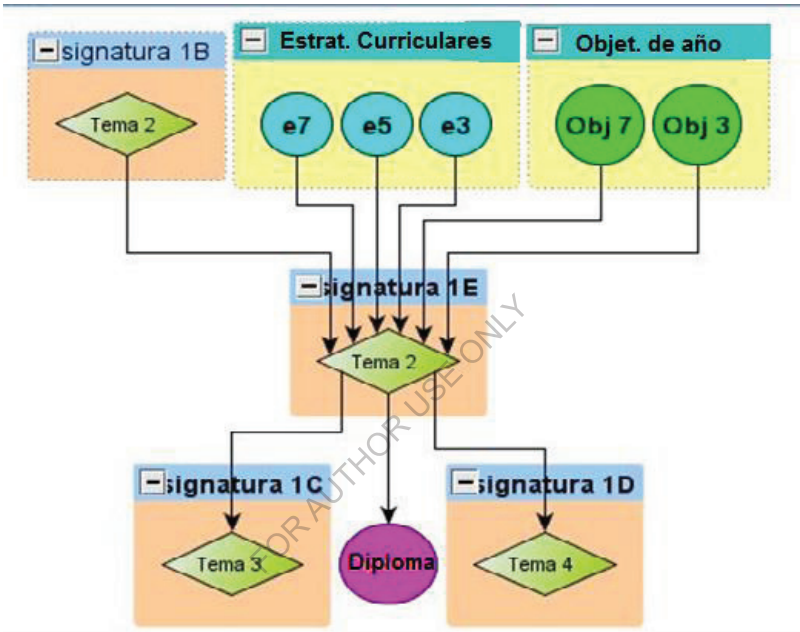


Figure 8- Interdisciplinary relationship of a topic “X” within the study plan

These interactions, which form competencies, could hypothetically have the following specific meaning, if it happens that:

- Topic 2 of subject 1B deals with “writing and interpretation of scientific documents”
- Topic 2 of subject 1E is about “preparation of an engineering project”
- The “e3” curricular strategy proposes “contributing to the development of oral expression in the mother tongue, in the presentation of scientific works.”

Therefore, the interaction of these elements, with others that could be presented throughout the study plan, should contribute to the student being able to prepare an Engineering project, following a certain format or methodology, and being able to write and Orally defend your degree thesis, upon completion of your diploma studies.

Of course, this is a simplified example of how it is possible for a graduate to be able to develop certain competencies at the base level, which, according to the Cuban model, are complemented after 2 years of on-the-job training. of work, and postgraduate improvement (specialization, master's, doctorate) that completes the professional training cycle (Ministry of Higher Education, 2016).

At first glance, at the schema level, everything can be concatenated perfectly, and one might think that achieving the interdisciplinary and transdisciplinary relationship is only a matter of time. It is enough to follow the logic of the scheme following the respective links, and after establishing the respective coordination between teachers, etc., and maintaining the respective base link as a guide for action, we would obtain in the end a graduate perfectly competent to solve the most general problems. of his newly opened job...

No, it is not the correct analysis. We're not even theorizing as we go; We are simply forgetting the main thing: what we see in the diagram in Figure 8 is nothing more than a dry disciplinary representation; physically, there are no interdisciplinary ties, much less transdisciplinary ones.

That is to say, the conceptual and procedural transfer (including skills in training) between disciplines can be carried out following the interrelation suggested in the scheme, but if such research does not exist, neither does the scheme! It is nothing more than a proposal based on experience, although the value of empirical evidence can support you.

What we are trying to highlight is the error that is made when, after developing a new study plan, we conclude the design task (embodied in a brand new curriculum) leaving it in the hands of the administrative management to create the logistics conditions. , so that everything is ready on the first day of classes, while the teachers organize and prepare the class materials for the respective subjects, give methodological orientation sessions to new teachers, etc. etc

But isn't this the routine every year? What does it matter that a new study plan begins, if subject "X" has already been taught so many times! Well, it does matter, and probably quite a bit. Only for a teacher who teaches his subject without even worrying about knowing the overall study plan of the degree, could the possible curricular transformations introduced in a new program be of little significance.

In any case, it is true, we always have to improve something, make new presentations, incorporate interesting videos that we did not have before; but what else? Isn't having 15 or 20 years of experience teaching the same thing enough for an expert teacher?

The answer is clear:

Attention: A new study plan, methodologically starting almost from ZERO.

This implies that, until that moment, it is only an official document, supported by stamps, signatures and all the corresponding attributes; But being new, it implies that the old experiences, the interdisciplinary relationships already established for the previous study plan, are not transferred, by decree, to the new program. They may have disappeared!

Therefore, there is the immense task that lies ahead of us: we are in the presence of a new study plan, which for the moment is only DISCIPLINE, it is still unknown (and that is why we must investigate) what the interdisciplinary and transdisciplinary relationships will probably be, which will gradually be established, as a result of scientific-methodological work.

But what about the accumulated experience? Obviously it does not have to have disappeared, it will simply be transformed from accumulated experience into potential experience, which is a primary source that researchers will have, committed to reaching a proposal for a transdisciplinary methodological mesh, from which it will be possible to address all the work. that corresponds to be carried out in each subject, and therefore in the entire study plan.

Only seen in this way does the diagram in Figure 8 acquire its true meaning. If we add as information that the relationships that it shows are the result of an ongoing investigation, which as a first contribution reflects a proposal for a transdisciplinary relationship, then we are able to *"put in black and white"*

what each person must do. (that is, what each member of the research team is responsible for doing) so that each arrow or relationship of the given scheme corresponds to one or more actions in the teaching activity in question, but this is already content that we will deal with. in the following section.

5.3 Theoretical methodological model for the study of interdisciplinary relationships

After establishing the criterion that a truly transdisciplinary study encompasses the antecedent and preceding interrelationships between the elements or nodes of a curricular mesh, the most complex task remains to be resolved, which is to implement, in teaching activities, the scheme. elaborated, which can be a starting point if you wish to subsequently identify the “*cognitive nodes*”, as proposed by Hernández, H. (2000).

When working following an already established competency-based training model, this is to a certain extent simplified because all competencies are already previously defined and the task is to identify which ones you specifically plan to work on, at what levels, and in what subjects that is. specific, although of course, in this case a specific interdisciplinary relationship is not being predefined.

An interesting example is illustrated with the following table, taken from Cavas, F (2015), which shows the planning of activities to be carried out to gradually achieve the development of certain learning objectives, which correspond to certain competencies. What is interesting is not reading the details, but rather the global information contained in the table, based on the actions planned.

	Resultados del aprendizaje (4.5)									
Actividades formativas (6.1)	1	2	3	4	5	6	7	8	9	10
Clase de teoría	X	X	X	X	X	X	X	X	X	X
Clases prácticas. Resolución de problemas tipo y casos prácticos	X		X	X		X		X		X
Clases de prácticas CAD, Sesiones de aula de informática	X	X	X	X	X				X	X

Figure 9. Visual image of an EHEA planning table Cavas, F (2015)

The EHEA standard model allows for a fairly detailed level of planning. In reality, it is a very extensive document, from which practically nothing escapes, and allows you to declare exactly what competence you are working on, what teaching activity, what didactic actions you intend to achieve, etc.

In our case, we will accompany the text with our own proposal, which offers elements that allow a level of graphic representation of the corresponding meshes, also considering the general methodological conception of the proposed model.

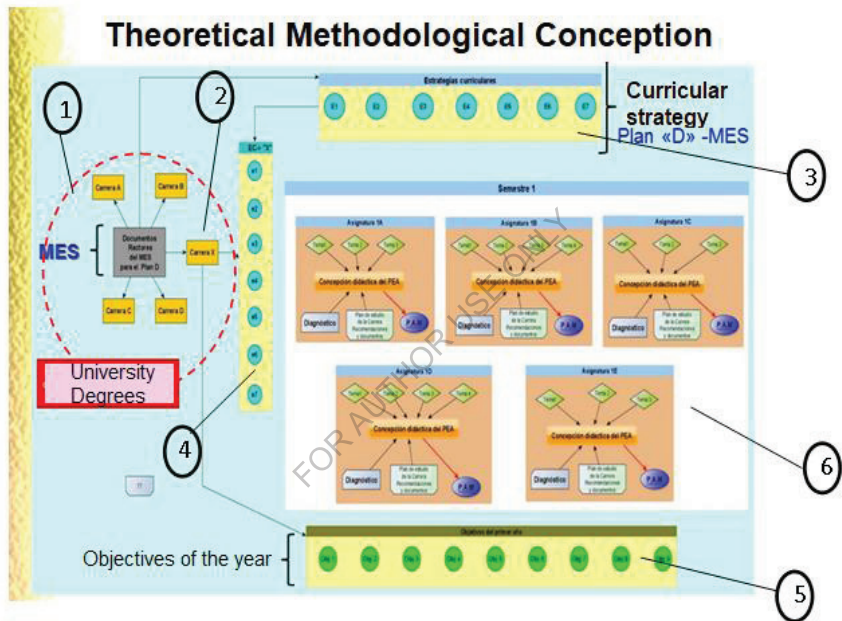


Figure 10- Theoretical model for the interdisciplinary study of a career

The figure offers a general view of the elements present in the theoretical model, from which it is proposed to obtain the interdisciplinary vision, which in this case makes the panning effect on the curricular map, where the system viewer specifically shows the particular vision for the first semester of a career "X".

According to the identification numbers, the following components are recognized:

1. Represents the Ministry of Higher Education (MES), including governing documents of the study plans, and the careers studied in Cuba
2. Refers to career "X", for which the interdisciplinary study is proposed.
3. Identify the general conception of Curricular Strategies declared by the MES.
4. Identify the specific Curricular Strategies, declared in the study plan of career "X".
5. Identify the Year Objectives of Career "X". In this case, it refers to the Objectives of the first year.
6. It includes the set of subjects corresponding to the first semester of the first year.

As can be seen in the diagram, for any semester of the study plan, all the mentioned components are present: Ministerial directives to prepare the study plan for each career "X"; the program of each subject of career "X"; the general curricular strategies declared by the MES, and how these are reflected in each degree program; and the objectives of the academic year in question.

We could affirm that we are in the presence of the initial position. Nothing is known beyond the criteria taken into account by the specialists who designed race "X". At this time there are no solid criteria that allow the listed components to interact, because we would be ignoring the interaction that must be previously established between:

Asignatura "X" (Asignatura 1; Asignatura 2 ... n; E. Curriculares de "X"; Objetivos del año en "X")

That is, as long as the study is not carried out that shows the interrelation of each subject with the rest (at a horizontal and vertical level), and is also combined with the declared curricular strategies and with the objectives of the academic year declared in the study plan. , we cannot say that we know a first interdisciplinary version of the curricular framework with which we are working.

If in such a situation the academic managers give the signal to start, and the first classes of the subjects begin to be taught, we would be in the presence of

a blind start, and in the best of cases we could declare that career "X" will be has been implemented, according to a disciplinary model, which is based on the potential interdisciplinary experience of the faculty, nothing more.

Therefore, it is understood that we are trying to demonstrate that no study plan will work in a transdisciplinary way if it is not implemented taking into account the results of the corresponding scientific-methodological research, which is developed in parallel, as part of the continuous improvement of the model. pedagogical in question.

The hypothetical interaction between all these components, a result of the investigative process (understood by the MES, in Cuba, as Scientific - Methodological Research) is presented in the following diagram (Figure 11), which shows a hypothetical relationship between all the components that are present. . This diagram was made using the yEdGraph Editor program, although there are no limitations so that another one can be used in its preparation.

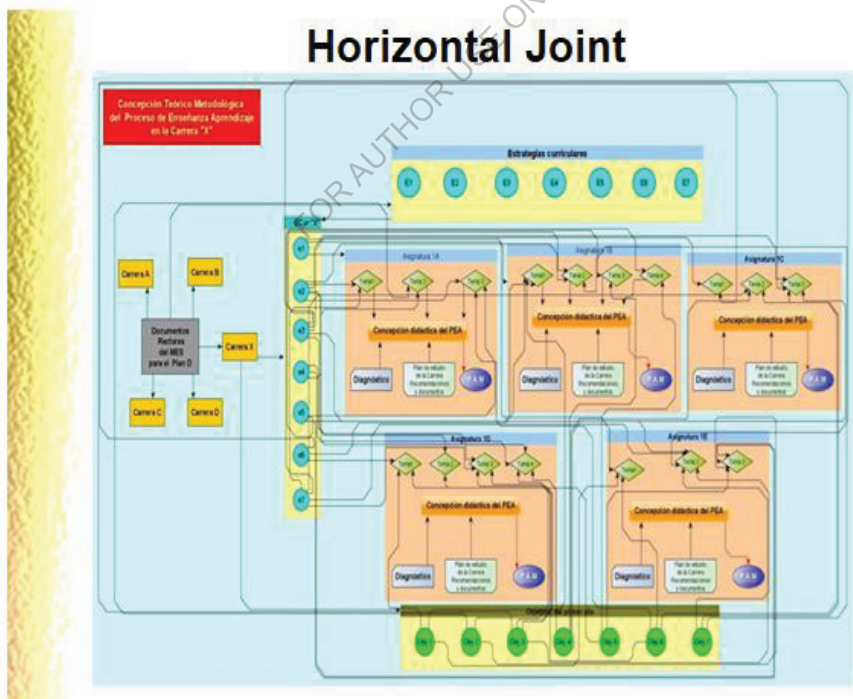


Figure 11- Example of interdisciplinary horizontal articulation. (1st year – 1st semester).

It is obvious that such interconnection of elements was not born from nothing. Here each one of them is an antecedent or precedent of another; and if we see it at the level of the complete curriculum, any component could be represented according to the example shown in figure 8, which as a reminder we now reiterate reduced in size, only to serve as a reference for the reader.

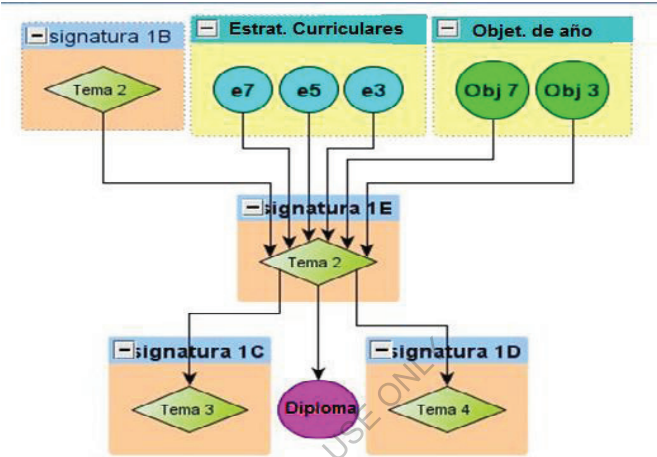


Figure 12- Reduced reproduction of figure 8

Based on what we have already commented, when reading this diagram we can focus our attention on Subject 1E, and within this we can consider that the research provides that at least 6 links are identified. These links show that, when working on the methodological preparation of topic 2, the following must be taken into consideration:

- The parallel relationship that is presented with topic 2, of subject 1B
- The need to take into consideration that this topic can contribute to the formation of curricular strategies (e7, e5 and e3).

It is worth noting that, if it were competency-based training, these would replace the aforementioned curricular strategies in the scheme, and the model would function in a similar way.

- In addition, topic 2 that we are evaluating has the possibility of contributing to the fulfillment of Objectives 7 and 3, of the first year of degree “X”.

- If the curriculum works in accordance with interdisciplinary research, this subject will contribute to the teaching of topic 3, of subject 1C; and from topic 4, from subject 1D.

Finally, an interesting contribution in situations like this is that it is possible to anticipate and specify the precedence that a specific subject may have in the final project or Diploma, because it can contribute to the teaching of the subject being carried out according to a specific plan. of its contents, or its equivalent when working on competency-based training.

5.3.1 Components of the theoretical methodological model

In the preceding analyzes explanations associated with the schemes have been inserted, seeking that by induction the essence of the components of the theoretical methodological model is assumed by the reader, although at this point, you will surely be wondering how it is possible to obtain all the information that each scheme requires, and also the way of how it is possible to integrate all these elements, in order to achieve the results that have been discussed as an example in the pages of this chapter.

It is now necessary to incorporate those elements that precisely constitute information organization tools, of which we will only comment on those that may have the greatest impact on the construction of direct, interdisciplinary relationship schemes, which in the end allow for global implementation, at the level of the curricular mesh. of a career study plan.

It should be noted that since we are working for the Cuban model, Curricular Strategies and Year Objectives are considered among the components. But if the reader considers that the proposal we make is applicable to a competency-based training model, these would perspectively take the place of the Curricular Strategies, and even the Year Objectives, depending on whether they are generic, transversal, specific, etc., depending on the original model.

We will begin by considering the following table, which we give as a figure, because its inclusion responds to its illustrative nature.

Among the subjects of the first semester of the first year

Nº	Asignaturas	1	2	3	4	5	6	7	8
1	Mathematics		X	X	X	X	X	X	
2	Algebra	X		X	X	X	X	X	
3	G. Descriptive	X	X		X	X	X	X	
4	History of Cuba	X	X	X		X	X	X	X
5	Intro Mech. Engeen.	X		X	X		X	X	X
6	Computer Science	X	X	X	X	X		X	X
7	English Language	X	X	X	X	X	X		X
8	Sports				X		X		

Legend	X	Content Articulation
	X	Context binding
	X	As a tool

Figure 13- Example of horizontal articulation table

The figure shows a table proposal that allows reflecting the horizontal link between the subjects of a semester, in a given degree. There is a significant element, and that is that the incorporation of a code (in this case color) allows us to show relationships that are generally not visual in a double-entry table.

In this case, the filling of the boxes in the table can be carried out by a researcher from the team, as a proposal, and then taken to the Year Collective, an organizational structure that we mentioned before, and which integrates all the teachers of the year. academic, and a representation of the students.

The important thing is that it is possible to establish different types of interrelation between the subjects, which in this case considers 3 main possibilities, although clearly there are others not contemplated:

- **Content articulation.**

It reflects the relationship between the thematic contents of the two subjects. If it is in the same semester, it is generally not of precedence; Otherwise, there will be precedence of a specific content, of one subject over the other.

- **Context binding**

For example, the historical context. In the case of the table, the subject History can serve as a context in the teaching of almost all subjects, except in the case of the subject Introduction to Mechanical Engineering, for which it constitutes an articulation of content between both.

It is also an important relationship. It becomes more evident, for example, when the student receives the content of Computer Science (as a subject) in that subject, and from there he can apply it in tasks, etc. of the remaining subjects.

However, there may be links that are transdisciplinary, when the impact occurs through the study plan, and in that case Computer Science, as a subject, would not be reflected in the example table; In this case, the idea is already induced that the alternative would be to work on a general, square table, with all the subjects of the curriculum, and the possibilities could be diverse, because in that case each box could also reflect, in a also coded, if the relationship considers precedence, weight of precedence on a given scale, etc.

A second integrating table is the one shown in the following figure.

[illegible]

The table directly relates the fulfillment of certain first-year objectives, of the degree in question, with the declared curricular strategies (A, B, C...) in the study plan, specifically indicating, for each subject, where the different subjects affect (although the example only shows cases in the Mathematics I subject), so

that, with such information in hand, it is possible to conceive concrete actions in a specific class activity.

The latter is exemplified by the table in the following figure. See punctuation marks to guarantee coherence of the idea.

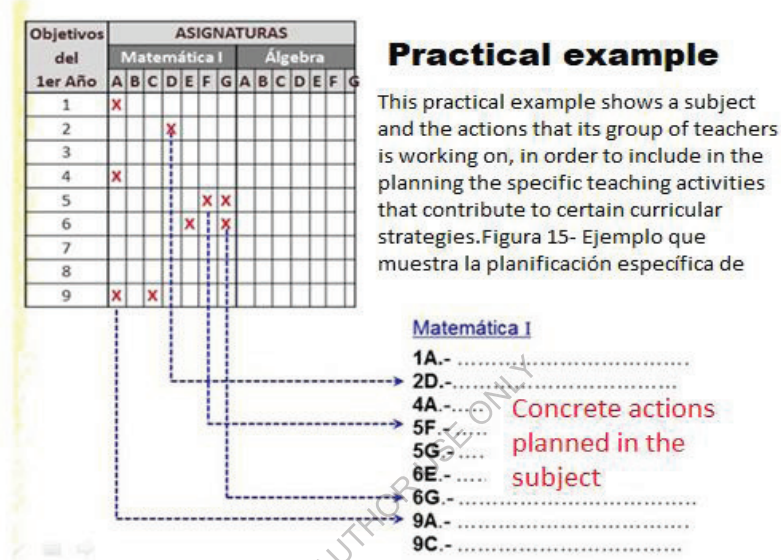


Figure 15- Example showing specific content planning

The information provided in the table allows planning and visualizing in which Objective-Strategy interrelationships, each subject (only Mathematics I is exemplified) is carrying out or is planning to carry out specific actions that contribute to curricular strategies A, B... G. Reading by Objectives allows you to evaluate the horizontal articulation between subjects.

Just imagining what the table would look like, when it has incorporated the information from all the subjects, one feels astonishment and even doubts that such a methodological conception can be put into practice.

Precisely how we consider that such research can be put into practice, we will discuss in the two sections that close the chapter.

5.3.2 The curricular mesh as a basis for staggered interdisciplinary study

First of all, we must establish a starting principle. An investigation of such magnitude can only be undertaken with a chance of success when there is a

team of researchers and collaborators who are interested and committed to its objectives; and they obtain from these results, at least, concrete academic compensation, which is the basis of personal motivation.

But the above may be insufficient, if at the same time there is no institutional support that endorses the mission of continuous improvement, and consequently supports the project with the resources that may be logistically needed, the minimum being a salary budget allocation dedicated to the ruble. of research, as well as funds for participation in events, publications, stimuli, trips, etc.

However, although logistics are not always guaranteed, it is important to keep in mind an immaterial aspect that can move the main personal interests. If a fact can be compensatory, it is that how much, how regular or how little can be achieved, will never be sterile work, it will always leave a concrete benefit, because that is what is characteristic when one works acting based on the continuous improvement of Higher Education.

Another aspect to consider is the choice of procedures for interdisciplinary work, reported in the state of the art of the topic, which could provide a theoretical foundation, while enabling useful tools in investigative work.

It is possible to recommend, for example, the determination of the potential nodes of interdisciplinary articulation, understood as the content of a topic, a discipline or subject, which includes the knowledge, skills and values associated with it, which can be identified through based on its thematic structure, its internal logic and intradisciplinary relationships, because it has the possibility of serving as the basis for a process of interdisciplinary articulation in a career (Fernández de Araiza, B. (2000:38).

In the aforementioned work, the use of potential nodes is worked in depth, based on their characterization, while the difference is established with respect to the use of cognitive nodes, suggested in the work of (Hernández, 1995, 2000), since the nodes of articulation have other origins and purposes.

Having established these premises, it is worth noting that, determined to undertake the project, we cannot forget that we are acting on a system, and that it works in a phased manner; That is, work will not be carried out in

parallel in the groups of all years of the “X” degree, but rather the research activity will be developed, in general, in a sequential and staggered manner.

A second aspect, which is a consequence of the previous one, is that we cannot aspire to achieve 100% results, as if it were a technological research, whose objective is to deliver a product that satisfactorily responds to the objective, and obviously a solution to the problem of departure.

We must not lose sight of the fact that the result achieved is always progress, no matter how small it may seem. That is why working modularly allows setting relative goals that deliver partial results. That is where the concept of continuous improvement lies. We will always have the possibility of completing and improving a result.

Let's say, for example, the design of a laboratory practice, which includes virtual activities, environmental research, use of foreign language literature, intensive use of computing, correct use of protective means, and a basic command of language proficiency. maternal, and technical, to correctly prepare the corresponding reports.

How many possibilities to perfect, to create and to do science do we often have at our fingertips, and we lose, without realizing it, a good doctoral topic, or simply prepare a proposal for a scientific event?

Therefore, we can summarize that an important starting criterion, to be able to successfully undertake this type of research, where the curricular, the pedagogical, and the didactic, at times are interrelated, is to have a curricular framework that considers a first interdisciplinary version, prepared from the potential experience of the professors, and where it is essential to also have the collaboration of less experienced professors, because everyone will be able to develop tasks according to their profiles, considering the possibility of even conceiving a doctoral pyramid, and a distribution of tasks that covers the different year groups.

Once the objective of this initial stage has been achieved, it is then possible to move on to the stage of complementing said mesh, gradually, with the results that are achieved in the study of interrelation between thematic contents of the subjects, and the identification of links and their respective actions. , to

achieve global interrelation, which considers curricular strategies and year objectives.

But not everything depends 100% on the money that can be allocated to us, and on each person's motivation. We will talk about that below.

5.4 The human component in multidisciplinary research

Although in previous pages it was established that, with regard to this work, the terminology within the disciplinary context would adjust to three well-defined moments: disciplinary, interdisciplinary and transdisciplinary.

However, this section begins with reference to a fourth possibility, multidisciplinary.

This inclusion does not change the assumed epistemological reality. By considering research as multidisciplinary, its universe is being framed: all disciplines must intervene in it, it is multidisciplinary research, and its participants carry out interdisciplinary and transdisciplinary studies.

Not to add new arguments about the polysemic nature of the topic, we first dedicate a space to raise the criteria that link complex thinking with the development of professional skills, in its different alternatives, but obviously, the topic has not been exhausted.

If it is about training professional skills, we assume that the proposal outlined here, based on a previous interdisciplinary study, is not out of context, and in principle can be considered feasible to put into practice, which in fact is an objective that since It has been developing for decades in Higher Education in Cuba.

What is new then? In that we are proposing a way, a methodological tool, that facilitates the task, but always within the concept of developing scientific methodological work, based on the continuous improvement of Higher Education, according to the face-to-face and blended models that are applied in Cuba.

A key aspect related to the feasibility of applying this methodological conception, for the development of an interdisciplinary study in the economic and sociocultural conditions of countries like Cuba, is that it is not possible to take a single firm step, if it is not possible to unconditionally involve in the tasks,

to all the people who constitute the human potential who will have the professional mission of carrying it out.

How to achieve the commitment of a main discipline or subject teacher to participate in the interdisciplinary study, contributing to the development of the curriculum with his empirical knowledge about the interrelationships between disciplines?

What follows is an interesting proposal.

This is not a problem that has not been considered before. At this point it is important to present a set of conditions, which according to Ezequiel Ander-Egg, must be present for interdisciplinarity to be possible as an educational practice and in its connection with particular didactics.

The relationship is long, but it would be regrettable to cut it short. The document, reproduced in turn in (Alvarez, M. 2001) considers the following aspects:

1. That each participating teacher has "good" (or at least acceptable) training in their discipline.
2. That all teachers have a real interest in carrying out an interdisciplinary task, and not just to comply with a formality that is imposed on them, either by other colleagues or by the management of the institute, college or school.
3. It is difficult for students to be motivated to carry out work of this nature if the teachers do not first have a minimum of enthusiasm for the task and if they are not able to propose a topic that is sufficiently attractive and interesting.
4. That all teachers internalize all those substantial aspects that an interdisciplinary conception and approach entails.
5. As a prior task, a reference framework is developed in which the fragmentary aspects that have been considered from each of the subjects/disciplines involved are integrated, organized and articulated.
6. That we work with a reference framework that is the framework of the pedagogical strategy that must allow adequate coordination and articulation of the specific work carried out in each subject.

7. Choose a topic that, by its nature, lends itself to carrying out a pedagogical work, taking into account that teachers and students are not scientists, but rather educators and students.
8. Do not assume that all subjects must be integrated, but only those that can contribute significantly to the topic or problem chosen as the object of study.
9. Begin the activity with a reading, comment and discussion of the reference framework to have an overview of the work and to share a common approach.
10. Jointly, and at the time when teachers make specific contributions to their respective disciplines, outline the groups of students who must work in depth on specific and specific topics. The definitive work groups must be formed according to the interests and abilities of the students, once a certain development of the topic has been carried out.
11. Make the necessary setups for the presentation of the results of the interdisciplinary work. This involves everything from the preparation of information sheets and posters to the conditioning of the premises and the organization of any necessary assemblies, ensuring a unitary character and a logical order.
12. Carry out the presentation of the topic or problem studied interdisciplinarily. This presentation can be made for the entire educational community (teachers, students, parents) or for the community (neighborhood, town or city) when the nature of the topic so advises. (Ander-Egg, 1993: 76-77)

A similar relationship, but adjusted to the Cuban context, is included by Marta Alvarez, in the cited work (Alvarez, M. 2001: s/p):

1. Study the governing documents of the level of education in question, including the guiding programs and the different disciplines of the area.
2. Diagnose the context (students, teachers, school, family, community).
3. Determine the pedagogical problem and the objectives that should be prioritized according to the context.
4. Build the reference framework.

5. Develop learning situations that allow the achievement of objectives from the perspective of different school disciplines. That is, select the problems, objectives, contents, methods, means, organizational and evaluation forms to be used (didactic model), taking into account the conditions of the context.
6. Apply the didactic model that allows organizing the students' thinking and directing their actions towards the proposed objectives.
7. Evaluate together with the students (and the school and surrounding community) the interest, the significance and productivity of the learning and the values and attitudes reflected, the quality of the tasks set and their direction by the teacher.

Como se aprecia, todas las acciones se dirigen a determinar y satisfacer las necesidades educativas del contexto, así como a evaluar la eficacia de las mismas.

Now, regardless of good professional relationships between colleagues, it must be considered that it is necessary to have an academic development program that stimulates, in one way or another, all potential researchers and collaborators.

It is understood that the above is applicable to Heads of Discipline, Main Subject Teachers and Year Group Teachers, etc. and it is designed in the sense that they see in this participation a concrete way to obtain recognition, whether through participation in events, publication of articles, participation in research with an assigned time fund, etc.; but above all, because the magnitude of the task gives the possibility that, in each discipline, master's and doctoral theses can be developed, with no limits other than what is derived from the lack of vision that we have, so as not to be able to transform the classic routine work (called methodological) into scientific methodological work, which has been the source that has led to the academic development of Pedagogical Sciences in Cuba, put into function of the training of professionals.

In this sense, the development of a feeling of brotherhood, in the Dumas style, but which we will call academic, can contribute to the union of all efforts, where each and every one feels that they are part of the collective result.

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A N E X O

Engineering Graphics Discipline

Main specific and transversal competencies at the Base Link level

No	Identified competencies	Drawing 1		Drw II	Own curriculum
		48 h	64 h		
1	He masters the general principles of two-dimensional geometry that allow him to graphically solve technical application problems in his specialty.	3	4	5	X
2	Masters the practical execution of representation in the Dihedral and Axonometric System. Is capable of quickly representing, through sketches, the views of an object of medium complexity, with its dimensions and technical specifications; or to carry out the reverse process, tracing the axonometric representation of bodies and industrial parts, starting from their dihedral projections.	3	4	4	¿?
3	Interprets, applies and values the importance of the standards and conventions used in Technical Drawing, relative to their specialty; and is able to interpret or document those corresponding to other branches of engineering, frequently used in related specialties.	3	4	5	X
4	Understands technical specifications and is able to generally interpret the content of project plans, of his specialty or related profiles, in the works execution phase.	2	3	4	X
5	Distinguishes and identifies the different elements that are part of an assembly, obtaining, through sketches or by automated means, the corresponding exploded drawings, including the necessary dimensioning, and the corresponding technical specifications, depending on the technological process that will be used in the elaboration of the object, or for its acquisition as a standardized piece.	3	3	4-5	X
6	Has the capacity for spatial vision and basic mastery of graphic representation techniques, to provide solutions in an operational and rapid manner, on site or in an exchange with colleagues and technicians, to engineering problems that arise in the work dynamic, using both traditional methods of conventional mathematical calculation, and knowledge of metric geometry, descriptive geometry, technical measurements applied to fits and tolerances, structural calculations or other special requirements, and computer-aided design.	1-2	3	4	X
7	Self-learning capacity, based on learning strategies that allow you to identify the relevant knowledge in your field of professional competence, articulated with graphic language, generating resources that allow you to acquire new knowledge necessary in your professional development.	3	4		X

8	Skillfully uses integrated CAD design techniques (Computer Aided Manufacturing – CAM; Computer Numerical Control – CNC; Computer Aided Engineering –CAE; Finite Element Analysis –FEA, etc.) and is capable of to assume new technologies in this field, both to make use of them when their professional tasks require it, and to properly plan, guide and control the work of the draftsmen (or computer technicians specialized in CAD, etc.) generally responsible with that type of tasks, which may be under their direction.	1	1	3-4	X
9	It integrates the general and specific knowledge acquired in higher education, complemented by subsequent on-the-job training studies, and is capable of diagnosing and solving technical problems within its competence, with initiative, decision making, creativity, and critical reasoning. making use of the necessary technical documentation.	3	4	5	X
10	Manages the implementation, operation and maintenance of engineering systems, taking into account the requirements declared in the equipment documentation or in the methodologies, technological charters, safety regulations, etc.	3	3	4	X
11	Rationally manage technological resources, materials and others, which are assigned to be used in the production process, services, unforeseen productive or management expenses, always supported by auditable documents, of a commercial, technical or legal nature.	3	3	4	X
12	Consult technical literature and/or interpret project plans for industrial machinery and equipment, which can be prepared in different graphic representation systems, depending on the nation of origin, with reference systems and technical standards specific to the country or area of origin.	1	3	4	X
13	Participates with knowledge of the facts, in the development of projects, with direct intervention in the plans and/or the associated technical documentation, as it is a contractual document.	3	4	5	X
14	Participates on site in the preparation of clarifying sketches of project or resolution aspects, not contemplated in the project.	3	4	5	X
15	Intervenes in the creation and development of new manufactured products. Participates in the preparation of descriptive reports, plans and other documents.	3	4	5	X
16	Based on the documentation of a project and the real conditions in which the tasks in which it participates must be carried out, it is able to evaluate the rational use of available resources and consider or create alternatives.	3	3	4	X
17	Participates in the development of multidisciplinary projects, indirectly linked to tasks of their professional profile, that may require prior training and that determine the need to communicate professionally with specialists from different fields of engineering.	2	3	4-5	X

18	You are able to gradually acquire the skills and abilities that allow you to prepare exhaustive reports, within your field of competence, using technical documentation and the appropriate language, exploiting the possibilities of the computer technologies at your disposal.	3	3	4	X
19	Diagnoses and provides solutions to typical problems in its specialty, keeping in mind the technical specifications that are generally reflected in the documentation of machines and equipment, both for reasons of safety and hygiene at work or environmental protection, etc.; as well as specific instructions from the manufacturer, related to the industrial warranty offered in the post-sale period.	3	3	4	X
20	Projects, designs and/or participates in the execution of projects in their specialty, being able to gradually assume eventual or provisional responsibility for management tasks, and maintain professional exchange with specialists from related branches of engineering, economics and others. impact on the assigned task.	3	4	5	X

Legend: A scale of 1 to 5 is used to assess the expected scope at the level of each competence, according to 3 dimensions (Drawing I, Drawing II or Applied and own Curriculum)

CP means Practical Class or Exercise Class.

Classification:

The list of Competencies considered in the table are expressed based on the professional performance expected of the graduate at the Base Link level, including the training period, and considers technical tasks that to a greater or lesser extent require knowledge and skills obtained. in subjects of the discipline Drawing for Engineers.

Therefore, the document aims to offer a guide that allows making relative assessments of the incidence or contribution of this discipline, in the scope of certain competencies that require a transdisciplinary training process, in order to reach the scale = 5.

It then means that the possible options are:

(a) Drawing I (48 or 64) plus the CP; and **(b)** Drawing I (48 or 64) + Applied Drawing + CPPor example, In the event that the direction of a career opts for the version of Drawing I, with 48 hours, if that career does not have Drawing II in the curriculum, then to complete competency No. 6 in the Base Link, it would have to be done implementing in the own curriculum, teaching actions that compensate for the insufficiencies related to Engineering Graphics, present in the declaration of that Competency, to achieve maximum value (5).

But in relation to competencies 5, 8, 10, 11, 16, 18 and 19, the choice of any of the two variants (48 or 64) is indifferent, because it is estimated that they produce the same incidence. The difference lies in the fact whether or not Applied Drawing is taught in that career. In this case, if they do not have Applied Drawing in their curriculum, the achievement of that competence falls on their own curriculum, that is, in subjects from 3rd to 5th year, if the degree is 5 courses.

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